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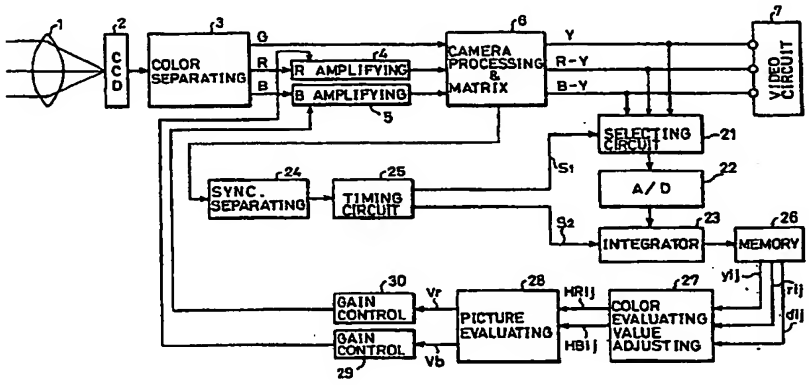
(54) A white balance adjusting apparatus for automatically adjusting white balance in response to luminance information signal and color information signal obtained from image sensing device.

(57) 64 regions are set on an image sensed picture of a video camera, where each evaluating values r_{ij}, b_{ij}, and y_{ij} are obtained by averaging color difference signals R-Y and B-Y and luminance signal Y obtained from an image sensed signal over 1 field period for each region. When determination is made that luminance evaluating value y_{ij} out of these evaluating values exceeds a predetermined value, the color evaluating values of the corresponding region are attenuated by a predetermined amount, in producing gain control signals regarding color difference signals. As a result, the effect of an object of high luminance towards white balance adjustment is reduced.

FIG.2



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A WHITE BALANCE ADJUSTING APPARATUS FOR AUTOMATICALLY ADJUSTING WHITE BALANCE IN RESPONSE TO LUMINANCE INFORMATION SIGNAL AND COLOR INFORMATION SIGNAL OBTAINED FROM IMAGE SENSING DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to white balance adjusting apparatus, and more particularly to a white balance adjusting apparatus in an image sensing apparatus such as a color video camera for automatically adjusting white balance to correct the wavelength distribution of light differing by each light source, according to the luminance information signal and the color information signal within the image sensing signal obtained from an image sensing device.

Description of the Background Art

In taking an object using an image sensing apparatus such as a color video camera, the wavelength distribution of light illuminating the object from a light source differs by the type of the light source. For example, the blue components are intensive in light from a light source of relatively high temperature, whereas the red components are intensive in light from a light source of relatively low temperature. It is therefore necessary to correct the wavelength distribution of each light source in order to properly reproduce the color tone of the object itself illuminated with light of the light source on the screen of a color monitor television receiver. This correction is generally called white balance adjustment, where the gain of each color signal is adjusted so that the ratio of the amplitudes of the three primary color signals of red (hereinafter referred to as R), blue (hereinafter referred to as B), and green (hereinafter referred to as G) is 1:1:1.

In conventional image sensing apparatus, the detection of the three primary color signals R, G, and B is carried out according to light around the image sensing apparatus using a sensor provided for each color. However, white balance could not be adjusted correctly with such image sensing apparatus when the light source around the image sensing apparatus (for example, fluorescent light) differs from the light source illuminating the object (for example the sun), as in the case where an outdoor scene is taken from inside a room.

Recently, a method called TTL (through-the-lens) is proposed in which white balance adjustment is carried out, without providing separate sensors, according to color difference signals R-Y and B-Y within the image sensing signal obtained from an image sensing device. Such a method is disclosed in Japanese Patent Laying-Open No. 62-35792, for example. This method is based on the consideration that the object taken by an image sensing apparatus has various color area distribution (hereinafter referred to as the color distribution) and if this color distribution is averaged over a sufficient long time, the color components cancel each other to result in each color signal of "0", which is equivalent to a state of taking a complete white picture. By controlling the gains of respective color signals so that the values resulting from integration of color difference signals R-Y and B-Y over one field period, for example, become 0 to correct the offset of the color tone due to wavelength distribution of light of the light source.

Fig. 1 is a block diagram showing an example of a conventional white balance adjusting apparatus by the TTL method. Referring to Fig. 1, light from an object (not shown) enters an image sensing device 2 formed of a CCD via a lens 1. The incident light is photoelectric-converted into an electric signal and provided to a color separating circuit 3. Color separating circuit 3 extracts the three primary color signals of R, G, and B from this electric signal. The extracted G signal is directly provided to a camera processing and matrix circuit 6. The R signal and B signal are provided to camera processing and matrix circuit 6 via a gain variable R amplifying circuit 4 and a B amplifying circuit 5, respectively. Camera processing and matrix circuit 6 creates a luminance signal Y and color difference signals R-Y and B-Y according to the entered three primary color signals of G, R, and B. The outputs are provided to a video circuit 7 where luminance signal Y and color difference signals R-Y and B-Y are subjected to the well-known process to create a record video signal. This record video signal is provided to a video recording circuit not shown.

The two color difference signals R-Y and B-Y are applied to integrating circuits 18 and 17, respectively, to be integrated over a sufficient long time, for example over 1 field period of a video signal. The values resulting from integration are provided to gain control circuits 13 and 14. Gain control circuits 13 and 14 control the variable gains of B amplifying circuit 5 and R amplifying circuit 4 so that the values resulting from integration each becomes 0. This results in the amplitude ratio of 1:1:1 of the three primary color

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signals G, R, and B to adjust white balance.

In a conventional white balance adjusting apparatus of Fig. 1, there are some cases where at least one of the outputs of a plurality of light reception portions (not shown) provided for respective colors of R, G and B and constituting image sensing device 2 is saturated, when there is an object of significantly high luminance in a portion of the image sensed picture, such as in the case where a light source such as the sun is taken. The amplitude ratio of the three primary color signals R, G, and B provided from color separating circuit 3 is not proportional to the actual R, G and B components included in the light source. Therefore, there was a problem that white balance is offset in a direction not associated with the actual light source color temperature, when white balance was adjusted according to the not properly proportional three primary color signals R, G, and B.

The conventional white balance adjusting apparatus of Fig. 1 corrects the irregularity of the wavelength distribution due to light of the light source, based on the consideration that colors cancel each other so that the reproduced picture can approximate a substantially white picture if the various color distributions of the object itself are averaged over a long period. This method comprises an inconvenience that proper white balance regarding the object itself could not be achieved because the reproduced picture could not approximate a white picture even if the color distributions of the object included in the entire picture are averaged, when the area ratio of the three primary colors within the picture is not equal, that is to say, when the color distribution is not even, such as in the case where green lawn or a blue sky occupies a large area of the picture, or in the case where a human object wearing a red sweater is taken in a close-up manner. If the above mentioned white balance adjustment is applied to such an unbalanced state of white balance, the gain will be controlled so as to cancel the intensive color. In the case of a close-up of a person wearing a red sweater, white balance will be intense in blue unnecessarily which is the complementary color of red, resulting in a problem that the color of the object itself cannot be properly reproduced on the reproduced screen.

Particularly, blue sky will be located in the upper end of an image sensed picture when taken outdoors. White balance of the entire picture will be intense in the side of the complementary color of blue. Because there are many cases where the blue sky is located at the upper end of a picture, it is desirable to consider an effective solution.

when the luminance of an object is extremely low, each level of the three primary color signals of R, G, and B will be reduced to aggravate the S/N ratio. This will cause an unbalanced state of levels of signals R, G, and B to generate color difference signals even though the actual object is black, i.e. achromatic color. In the conventional white balance adjusting apparatus of Fig. 1, the gains of signals R and B will be varied to cancel these color difference signals, whereby white balance is intense in the complementary color side.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a white balance adjusting apparatus capable of appropriate automatic white balance adjustment even in the case where there is an object of extremely high luminance in the picture.

Another object of the present invention is to provide a white balance adjusting apparatus capable of appropriate automatic white balance adjustment, even in the case where the color area distribution of an object is not even.

A further object of the present invention is to provide a white balance adjusting apparatus capable of appropriate automatic white balance adjustment, even in the case where there is an object of a specified color in specified regions of the picture.

A still further object of the present invention is to provide a white balance adjusting apparatus capable of appropriate automatic white balance adjustment even in the case where there is an object of extremely low luminance in the picture.

Briefly stated, the present invention is a white balance adjusting apparatus for automatically adjusting white balance according to a luminance information signal and a plurality of color information signals obtained from an image sensing apparatus having a lens and an image sensing device. The white balance adjusting apparatus includes an amplifying circuit, a region setting circuit, luminance evaluating value and color evaluating value converting circuit, a gain control circuit, and a weight reducing circuit. The amplifying circuit amplifying each of the color information signals with a corresponding variable gain. The region setting circuit divides the image sensed picture to set a plurality of regions on the image sensed picture. The luminance evaluating value and color evaluating value converting circuit averages luminance information signal and respective ones of plurality of color information signals to convert the same into luminance evaluating value and color evaluating values for each of the plurality of regions. The gain control circuit is

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responsive to each color evaluating value of each of the plurality of regions for controlling the variable gain of the amplifying circuit. The weight reducing circuit reduces the contribution degree of each color evaluating value towards the control of the variable gain in regions where the luminance evaluating value is greater than a predetermined value.

In accordance with another aspect of the present invention, the weighing amount regarding the color evaluating values of each region is determined according to the luminance information signal of each region.

In accordance with a still further aspect of the present invention, the contribution degree towards variable gain control of color evaluating values in the corresponding specified regions is reduced, when the luminance evaluating value and the color evaluating value of a specified color in specified regions of the image sensed picture are greater than the respective predetermined values.

In accordance with another aspect of the present invention, the contribution degree towards variable gain control of each color evaluating value is reduced, in regions where the contrast evaluating value indicating the contrast of an object is smaller than a predetermined value.

In accordance with a further aspect of the present invention, the control of variable gain is limited according to the luminance information signal.

A main advantage of the present invention lies in that unnecessary offset of white balance of the picture is prevented even in the case where there is an object of high luminance in the picture.

Another advantage of the present invention lies in that white balance can be suppressed from being intense in the complementary color of the object, even in the case where the color area distribution of the object in the picture is not even.

A further advantage of the present invention lies in that white balance is not offset to cancel the corresponding specified color even in the case where an object of the specified color exists in the specified regions in the picture.

A still further advantage of the present invention lies in that unnecessary offset of white balance of the picture is suppressed even when there is an object of extremely low luminance in the picture.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of an example of a conventional white balance adjusting apparatus.

Fig. 2 is a block diagram of a white balance adjusting apparatus of a first embodiment of the present invention.

Fig. 3 is a diagram schematically showing the specified regions on the image sensed picture.

Fig. 4 is a block diagram showing the integrator of Fig. 2 in detail.

Fig. 5A is a block diagram showing the color evaluating value adjusting circuit of Fig. 2 in detail.

Fig. 5B is a block diagram showing another color evaluating value adjusting circuit of Fig. 2.

Fig. 6 is a block diagram showing a white balance adjusting apparatus of a second embodiment of the present invention.

Fig. 7 is a block diagram showing a white balance adjusting apparatus of a third embodiment of the present invention.

Fig. 8 is a block diagram showing the color evaluating value adjusting circuit of Fig. 7 in detail.

Fig. 9 is a block diagram showing another example of a color evaluating value adjusting circuit of Fig. 7.

Fig. 10 is a block diagram showing a white balance adjusting apparatus of a fourth embodiment of the present invention.

Fig. 11 is a block diagram of the color evaluating value adjusting circuit of Fig. 10 in detail.

Fig. 12 is a schematic diagram for explaining the operation principle of the fourth embodiment of Fig. 10.

Fig. 13 is a block diagram showing another example of the color evaluating value adjusting circuit of Fig. 10.

Fig. 14 is a block diagram of a white balance adjusting apparatus of a fifth embodiment of the present invention.

Fig. 15 is a graph for explaining the operation of the fifth embodiment of the Fig. 14.

Fig. 16 is a block diagram showing a white balance adjusting apparatus of a sixth embodiment of the present invention.

Fig. 17 is a graph explaining the operation of the sixth embodiment of Fig. 16.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 2 is a block diagram showing a white balance adjusting apparatus of a first embodiment of the present invention. Referring to Fig. 2, light from an object (not shown) enters an image sensing device 2 formed of a CCD via a lens 1. The incident light is photoelectric-converted into an electric signal and applied to a color separating circuit 3. Color separating circuit 3 extracts the three primary color signals of R, G and B from the electric signal. The extracted G signal is directly provided to a camera processing and matrix circuit 6, whereas signals R and B are provided to camera processing and matrix circuit 6 via a gain variable R amplifying circuit 4 and a B amplifying circuit 5, respectively. Camera processing and matrix circuit 6 produces luminance signal Y and color difference signals R-Y and B-Y according to the entered three primary color signals of G, R and B, and provides the outputs to a video circuit 7. The well-known processing are carried out to luminance signal Y, and to color difference signals R-Y and B-Y in video circuit 7 to produce a record video signal. This signal is provided to a recording circuit not shown.

Simultaneously, each of signals Y, R-Y, and B-Y is provided to a selecting circuit 21. Selecting circuit 21 is responsive to a selection signal S1 produced by a timing circuit 25 according to a vertical synchronizing signal provided from a synchronizing separating circuit 24, to sequentially select one signal out of luminance signal Y, color difference signal R-Y, and color difference signal B-Y for each 1 field. In the embodiment of Fig. 2 for example, the luminance signal or the color difference signal is selected for each field in the order of (Y) → (R-Y) → (B-Y) → (Y) → (R-Y) → ... . The selected signal is provided to the succeeding stage A/D converter 22.

A/D converter 22 samples one of signals Y, R-Y, and B-Y selected by selecting circuit 21 with a predetermined sampling period to convert into a digital value. The converted value is provided to an integrator 23.

Meanwhile, timing circuit 25 produces a switching signal S2 according to vertical and horizontal synchronizing signals provided from camera processing and matrix circuit 6, and the fixed output of an oscillator (not shown) for driving CCD 2. Switching signal S2 is provided to integrator 23. Integrator 23 is responsive to switching signal S2 to divide the image sensed picture into 8 x 8 = 64 rectangular regions A_{11}, A_{12}, A_{13}, ... , A_{ij} (i, j = an integer of 1-8) each of an identical area, for deriving the output of selecting circuit 21 in time divisional manner for each region.

More specifically, integrator 23 receives switching signal S2 to add the A/D converted values output from selecting circuit 21 over 1 field period for each region, i.e., digital-integrate the output of selecting circuit 21 for each region of the 64 regions, to hold the digital-integrated value corresponding to each region as a luminance evaluating value, or a color evaluating value in memory 26, after integration within 1 field period is completed. The digital-integrated value of luminance signal Y corresponding to respective ones of the 64 regions are obtained as 64 luminance evaluating values y_{ij} (i, j:1-8) in an arbitrary field. In the next field where color difference signal R-Y is selected by selecting circuit 21, the digital-integrated values for respective regions of the color difference signal R-Y are obtained as 64 color evaluating values r_{ij} as a result of integration for respective regions by integrator 23. At a further next field where color difference signal B-Y is selected by selecting circuit 21, the digital-integrated value for respective regions of color difference signal B-Y are obtained as 64 color evaluating values b_{ij} as the result of integration for respective regions by integrator 23.

When integration of luminance signal Y, and color difference signals R-Y and B-Y over 3 field periods is completed, a total 64 x 3 = 192 of luminance evaluating value y_{ij} and color evaluating values r_{ij} and b_{ij} are held in memory 26. Similar operation is repeated where a new luminance evaluating value y_{ij} is applied to memory 26 at the next field. At a further next field, color evaluating value r_{ij} is applied to memory 26. The luminance evaluating value and color evaluating values held in memory 26 are sequentially updated.

Fig. 4 is a block diagram of integrator 23 in detail. Each A/D converted data provided from A/D converter 22 is provided to a switching circuit 61. Switching circuit 61 receives switching signal S2 from timing circuit 25 for providing each A/D converted value into an adder provided corresponding to the region where the sampling point of the corresponding A/D converted data exists, out of the 64 adders F_{11}, F_{12}, ..., F_{88} provided corresponding to the 64 regions A_{11}, A_{12}, ... , A_{88} . For example, if a sampling point of an arbitrary A/D converted data is included in region A_{11}, switching circuit 61 provides this data to adder F_{11} corresponding to region A_{11}.

In the succeeding stage of each adder F_{ij}, a holding circuit Q_{ij} is provided, where the output of each adder is first held in the corresponding holding circuit. The data held in each holding circuit is applied to a corresponding adder again and added with the next applied A/D converted data. Although each holding circuit Q_{ij} is reset by each 1 field in response to a vertical synchronizing signal, only the data held immediately before reset is provided to memory 26. Thus, one digital integrating circuit is composed of one set of an adder and a holding circuit. Integrator 23 is composed of a total of 64 digital integrating circuits.

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This means that a digital-integrated value corresponding to each of 64 regions is applied to memory 26 from the holding circuit for each field.

The reference level, i.e. the 0 level, of each of the two color difference signals R-Y and B-Y provided to A/D converter 22 is set in advance to a level obtained when a complete achromatic color picture is taken. Therefore, the value obtained by A/D converting the color difference signal may take not only a positive value, but a negative value.

Referring to Fig. 2 again, the latest y_{ij}, r_{ij}, b_{ij} calculated as in the above manner and held in memory 26 are provided to color evaluating value adjusting circuit 27. Color evaluating value adjusting circuit 27 makes determination as to whether the level of luminance evaluating value y_{ij} of each region exceeds a predetermined value or not. When exceeding a predetermined value, the level of the color evaluating values of the corresponding region are reduced by a predetermined amount P.

Fig. 5A is a block diagram of color evaluating value adjusting circuit 27. Referring to Fig. 5A, luminance evaluating value y_{ij} of each region is provided to luminance comparator 41, to be compared with a luminance threshold value N_y stored in advance in a luminance threshold value memory 40. Comparator 41 generates switching signal S of the H level when luminance evaluating value y_{ij} is equal or greater than threshold value N_y, and of the L level, when less than threshold value N_y. The output is provided to switching circuit 42. This luminance threshold value N_y is set according to an experiment in advance as a threshold value for identifying that any of the outputs of light reception portions of respective colors of R, G, and B of the image sensing device is saturated.

Switching circuit 42 is implemented with two switches 43 and 44. Switch 43 functions to selectively connected a fixed contact 43a to which color evaluating value r_{ij} is applied to a fixed contact 43b coupled to R attenuator 45 or a fixed contact 43c coupled to output terminal 47. Switch 44 functions to selectively connected a fixed contact 44a to which color evaluating value b_{ij} is applied to a fixed contact 44b coupled to B attenuator 46 or a fixed contact 44c coupled to output terminal 48.

Both switches 43 and 44 are controlled by switching signal S from luminance comparator 41. When switching signal S is at the L level, switches 43 and 44 are turned to the sides of fixed contacts 43c and 44c, where color evaluating values r_{ij} and b_{ij} are directly provided to output terminals 47 and 48 as adjusted color evaluating values HR_{ij} an HB_{ij}, respectively. When switching signal S is at the H level, switches 43 and 44 are turned to the sides of fixed contact 43b and 44b, where color evaluating values r_{ij} and b_{ij} are provided to R and B attenuators 45 and 46.

R and B attenuators 45 and 46 subtract a predetermined constant amount P from the provided color evaluating values r_{ij} and b_{ij} to calculate r_{ij}- P and b_{ij} -P. This is provided to output terminals 47 and 48 as adjusted color evaluating values HR_{ij} and HB_{ij}, respectively. The constant amount P is a value obtained from an experiment in advance that can sufficiently identify that the picture quality is not unnatural when an object of high luminance is taken.

Referring to Fig. 5A, the operation of color evaluating value adjusting circuit 27 is explained hereinafter. When luminance evaluating value y_{ij} of a region is provided to color evaluating value adjusting circuit 27, this luminance evaluating value y_{ij} is compared with luminance threshold value N_y by luminance comparator 41. When luminance evaluating value y_{ij} is greater than the threshold value, determination is made that the object in the region is of high luminance to provide switching signal S of the H level to switching circuit 42. As a result, color evaluating values r_{ij} and b_{ij} are attenuated by a constant amount P by R and B attenuators 45 and 46 to be provided from output terminals 47 and 48. When luminance evaluating value y_{ij} is smaller than threshold value N_y, determination is made that the object is not of high luminance, and color evaluating values r_{ij} and b_{ij} are not attenuated and directly provided from output terminals 47 and 48. Only the color evaluating values of the region where an object of high luminance exists are attenuated.

The attenuated or not attenuated color evaluating values HR_{ij} and HB_{ij} provided from output terminals 47 and 48 are provided to picture evaluating circuit 28 of Fig. 2, where color evaluating values of the entire picture regarding respective color different signals are calculated as picture color evaluating values V_r and V_b, according to the following equations (1) and (2).

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$$V_r = \sum_{i=j}^{8} \sum_{j=1}^{8} HR_{ij}/64 \quad \ldots(1)$$

$$V_b = \sum_{i=j}^{8} \sum_{j=1}^{8} HB_{ij}/64 \quad \ldots(2)$$

By equations (1) and (2), the average value of one region is derived as a picture color evaluating value which is a color evaluating value of the entire picture, by dividing the total sum of the adjusted color evaluating values of the 64 regions provided from color evaluating value adjusting circuit 27 by the total number of regions.

Gain control circuits 29 and 30 control the gains of R amplifying circuit 4 and B amplifying circuit 5 so that both picture color evaluating values V_r and V_b become 0. When picture color evaluating values V_r and V_b becomes 0, white balance adjustment is completed.

Although the color evaluating value itself is directly corrected according to the adjusting process by color evaluating value adjusting circuit 27 in the embodiment of Fig. 2, it is possible to obtain similar results by weighting color evaluating values with a constant weighing amount in general state, and only reducing the weighing amount regarding color evaluating values of high luminance.

Fig. 5B is a block diagram showing another example of color evalauting value adjsuting circuit 27.

Regarding regions other than the high luminance regions, a predetermined weighting amount D1 is weighted on color evaluating values by weighting circuits 56 and 58, that is to say, the multiplication of r_{ij} x D1 and b_{ij} x D1 are carried out. Regarding regions of high luminance, weighting amount D2 smaller than weighting amount D1 is weighted by weighting circuits 55 and 57, that is to say, the multiplication of r_{ij} x D2 and b_{ij} x D2 are carried out. By providing these multiplied values as the modified color evaluating values of each region, it is possible to reduce the contribution degree towards white balance adjustment of the entire picture regarding regions satisfying the condition of $y_{ij} > N_y$.

According to the first embodiment of the present invention, it is possible to prevent offset of white balance adjustment to achieve appropriate white balance adjustment, by reducing the contribution degree of color evaluating values of high luminance portions towards white balance adjustment, even in the case where a scene including a portion having high luminance not suitable for white balance adjustment is taken.

Fig. 6 is a block diagram of a white balance adjusting apparatus according to a second embodiment of the present invention. The second embodiment of Fig. 6 is identical to the first embodiment of Fig. 2, except for the following points. That is to say, a picture evaluating circuit 50 is provided instead of color evaluating value adjusting circuit 27 and color evaluating circuit 28 of Fig. 2.

Picture evaluating circuit 50 of Fig. 6 fetches the latest evaluating values y_{ij}, r_{ij}, and b_{ij} (i, j:1-8) from memory 26 to calculate the color evaluating values of the entire picture regarding color difference signals R-Y and B-Y as picture color evaluating values V_r and V_b, according to the following equations (3) and (4).

$$V_r = \sum_{i=j}^{8} \sum_{j=1}^{8} (r_{ij} \times y_{ij}) \Big/ \sum_{i=j}^{8} \sum_{j=1}^{8} y_{ij} \quad \ldots(3)$$

$$V_b = \sum_{i=j}^{8} \sum_{j=1}^{8} (b_{ij} \times y_{ij}) \Big/ \sum_{i=j}^{8} \sum_{j=1}^{8} y_{ij} \quad \ldots(4)$$

The above equations will be explained hereinafter briefly. Equations (3) and (4) are equations multiplying and summing color evaluating values r_{ij} and b_{ij} of respective color difference signals by luminance evaluating value y_{ij}, considering that chroma is higher in portions where the luminance level is high, and likely to be white. In the above equation (3),

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$$\sum_{i=1}^{8} \sum_{j=1}^{8} (r_{ij} \times y_{ij})$$

is the total sum of the multiplication results of all 64 regions upon applying weight to color evaluating value r_{ij} of color difference signal R-Y in proportion to the luminance level, by multiplying color evaluating value r_{ij} of the 64 regions by the corresponding luminance evaluating value y_{ij}.

However, normalization of the weighing amount is not carried out only with the above

$$\sum_{i=1}^{8} \sum_{j=1}^{8} (r_{ij} \times y_{ij})$$

That is to say, the factor that a region having high luminance level occupies a large area in the picture will increase the color evaluating values of the entire screen.

Hence, normalization of the weighing amount is carried out by dividing the above mentioned total sum of

$$\sum_{i=1}^{8} \sum_{j=1}^{8} (r_{ij} \times y_{ij})$$

by the total sum of

$$\sum_{i=1}^{8} \sum_{j=1}^{8} y_{ij}$$

which is the total sum of the weighing amount of all regions. By multiplying and summing color evaluating value r_{ij} of the color difference signal over the entire picture using weighing amount y_{ij}, a picture color evaluating value V_r having area factors removed is derived.

In a situation where half of the regions forming an image sensed picture, i.e., 32 regions of the 64 regions, have an object of color evaluating value r_{ij} = 10 of color difference signal R-Y and luminance evaluating value y_{ij} = 10, with the remaining 32 regions completely of black color (y_{ij} = 0), the following total sum is obtained:

$$\sum_{i=1}^{8} \sum_{j=1}^{8} (r_{ij} \times y_{ij}) = 10 \times 10 \times 32 = 3200$$

Therefore, if normalization is not carried out with the weighing amount, the color evaluating value of the entire picture is calculated as 3200, whereby white balance adjustment is carried out according to this value.

Assuming another situation where an object identical to the above mentioned object, i.e. an object of r_{ij} = 10 and y_{ij} = 10, exists in regions corresponding to 1/4 of the image sensed picture, i.e. in 16 regions, and the remaining regions are completely black, the following total sum is derived:

$$\sum_{i=1}^{8} \sum_{j=1}^{8} (r_{ij} \times y_{ij}) = 10 \times 10 \times 16 = 1600$$

Because the object is completely identical and the regions where the object does not exist is completely a black level in either of the two situations, white balance adjustment must be carried out with respect to the identical object in either case. This means that the white balance adjustment amount must be the same adjusting amount even if the area ratio occupied by the object in the image sensed picture differs. There must not be difference regarding picture color evaluating values according to the area ratio of the high luminance level regions in the picture, such as the above 3200 and 1600. By dividing 3200 and 1600 by

$$\sum_{i=1}^{8} \sum_{j=1}^{8} y_{ij} = 10 \times 32 = 320 \text{ and}$$

$$\sum_{i=1}^{8} \sum_{j=1}^{8} y_{ij} = 10 \times 16 = 160, \text{ respectively, for}$$

normalization by the total weighing amount, picture evaluating value V_r will become V_r = 3200/320 = 1600/160 = 10 in either case, to adjust white balance with identical adjusting amount regarding R components.

Similarly, the above equation (4) can derive the normalized color evaluating value of the entire picture as picture color evaluating value V_b, by adding and multiplying color evaluating value b_{ij} of color difference signal B-Y of each region over the entire picture by luminance evaluating value y_{ij}.

Referring to Fig. 6 again, gain control circuits 29 and 30 control the respective gains of R amplifying circuit 4 and B amplifying circuit 5 so that picture color evaluating values V_r and V_b both become 0 which are the color evaluating values regarding the entire picture. When picture color evaluating values V_r and V_b become 0, white balance adjustment is completed.

According to the second embodiment of the present invention, it is possible to suppress the offset of white balance to the complementary color side to improve the reproduction of the actual color of the object, by increasing the effect of color signals in regions of high luminance probably white towards white balance adjustment, even when the color distribution of the image sensed picture is not even.

Fig. 7 is a block diagram showing a third embodiment of the present invention. The third embodiment of Fig. 7 is the same as the first embodiment of Fig. 2, except for the following points. That is to say, a color evaluating value adjusting circuit 60 is provided instead of color evaluating value adjusting circuit 27 of Fig. 2. Evaluating values y_{ij}, r_{ij}, b_{ij} held in memory 26 are provided to color evaluating value adjusting circuit 60.

Color evaluating value adjusting circuit 60 makes determination whether an object having a particular luminance level and a specified color exists in the specified regions previously selected out of the 64 regions. When such an object exists, the color evaluating value level of the corresponding region is reduced by a predetermined amount Z.

In general, there is high probability that blue sky is located at the upper side of the image sensed picture when taken outdoors. Blue sky is an object in which the luminance level is relatively high and which color difference signal B-Y is significantly high. It is probable that the picture will be intense in the blue components considering the entire picture. In the third embodiment, the 16 regions in the 2 topmost rows of the picture are selected as the specified regions with blue as the specified color.

Fig. 8 is a block diagram of the color evaluating value adjusting circuit 60 of Fig. 7.

Referring to Fig. 8, luminance evaluating value y_{ij} of each region is applied to luminance comparator 62 from the topmost region in the order of $y_{11} \rightarrow y_{12} \rightarrow \ldots y_{18} \rightarrow y_{21} \rightarrow \ldots \rightarrow y_{88}$, to be compared with luminance threshold value n_y stored in luminance threshold value memory 63 in advance. The comparison operation by luminance comparator 62 is carried out only when the luminance evaluating value from the region selected in advance by region selecting circuit 64 is applied. In the third embodiment, the above mentioned blue sky is recognized as an object of the specified color, where the regions specified by region

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selecting circuit 64 are set to 16 regions A_{11}, A_{12} ... A_{28} corresponding to the topmost 2 rows of the image sensed picture. Therefore, the comparison operation by luminance comparator 62 is carried out with respect to only the luminance evaluating values of the 16 regions. As a result of the comparison operation, comparison signal S3 of a H level associated with the corresponding region is generated from luminance comparator 62, when determination is made that luminance evaluating value y_{ij} is greater than luminance threshold value n_y.

Color comparator 65 compares the levels of color evaluating value b_{ij} and B threshold value N_b stored in color threshold value memory 166, only when comparison signal S3 is at the H level. Only the color evaluating values b_{ij} of the regions where the luminance evaluating value is determined to be greater than luminance threshold value n_y by comparison of luminance comparator 62 will be compared with B threshold value N_b. As a result of the comparison operation, comparison signal S4 of a H level is generated regarding the corresponding region from color comparator 65 only when color evaluating value b_{ij} is greater than B threshold value N_b.

Referring to Fig. 8, switching circuit 66 is constituted by two switches 67 and 68. Switch 67 functions to selectively connect a fixed contact 67a to which color evaluating value b_{ij} is applied to a fixed contact 67b coupled to B attenuator 69 or a fixed contact 67c coupled to output terminal 71. Switch 68 functions to selectively connect a fixed contact 68a to which color evaluating value r_{ij} is applied to a fixed contact 68b coupled to R attenuator 70 or a fixed contact 68c coupled to output terminal 72.

Switches 67 and 68 are switch controlled synchronously with comparison signal S4 as a switching signal. When comparison signal S4 is at the L level, switches 67 and 68 are switched to the sides of fixed contacts 67c and 68c, where color evaluating values b_{ij} and r_{ij} of the corresponding region are directly provided to output terminals 71 and 72 without being attenuated. When switching signal S4 is at the H level, switches 67 and 68 are switched to the sides of fixed contact 67b and 68b, respectively, where color evaluating values b_{ij} and r_{ij} of the corresponding region are applied to B and R attenuators 69 and 70, respectively.

B and R attenuators 69 and 70 subtract a predetermined amount Z from the applied color evaluating values b_{ij} and r_{ij} to derive b_{ij} -Z and r_{ij} -Z. The results are provided to output terminals 71 and 72.

Regarding regions A_{11}, A_{12}, ..., A_{28} selected in advance, color evaluating value adjusting circuit 60 makes the determination as whether:

(I) the object has sufficient luminance level where luminance evaluating value y_{ij} (i = 1, 2:j = 1-8) is greater than luminance threshold value n_y,
and also
(II) the object has significantly intensive blue components, where color evaluating value b_{ij} (i = 1, 2:j = 1-8) is greater than B threshold value N_b,

where evaluating value adjusting operation is carried out to attenuate color evaluating values b_{ij} and r_{ij} by a predetermined amount Z regarding the region satisfying both (I) and (II).

Luminance and color evaluating values y_{ij}, b_{ij}, and r_{ij} are provided to color evaluating value adjusting circuit 60 synchronously from memory 26 for every identical region. The operation within color evaluating value adjusting circuit 60 is carried out sequentially for all the 64 regions.

Threshold values n_y and N_b are values set according to observation data for recognizing blue sky. The attenuating amount Z is a value set according to an observation value where appropriate white balance is implemented in an image sensing state having blue sky in the selected regions of A_{11}, ... , A_{28}.

The attenuated or not-attenuated color evaluating values b_{ij} and r_{ij} provided form output terminals 71 and 72 are applied to picture evaluating circuit 28, where the color evaluating values of the entire picture regarding respective color difference signals are calculated as picture color evaluating value V_r and V_b according to the following equations (5) and (6).

$$V_r = \sum_{i=1}^{8} \sum_{j=1}^{8} r_{ij}/64 \qquad \ldots(5)$$

$$V_b = \sum_{i=1}^{8} \sum_{j=1}^{8} b_{ij}/64 \qquad \ldots(6)$$

According to equations (5) and (6), the total sum of each of the adjusted color evaluating values r_{ij} and

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b_{ij} of the 64 regions provided from color evaluating value adjusting circuit 60 is divided by the number of regions to derive the average value of one region as the color evaluating value which is the color evaluating values concerning the entire picture.

Gain control circuits 29 and 30 control each gain of R amplifying circuit 4 and B amplifying circuit 5 so that picture color evaluating values V_r and V_b both become 0. When picture evaluating values V_r and V_b both become 0, white balance adjustment is completed.

According to the third embodiment of the present invention, specified regions are set in the upper side of the picture and blue is selected as the specified color. The effect of blue components of the blue sky towards white balance adjustment can be suppressed to prevent white balance of the entire picture from being intense in the complementary color side of blue, even when blue sky exists in the image sensed picture. The specified region and the specified color can be selected arbitrarily. For example, it is possible to suppress the effect of red components of a sunset towards white balance adjustment to prevent white balance from being intense in the complementary color of red, by setting the specified regions in the upper side of the picture and select red as the specified color, and by applying color evaluating value r_{ij} instead of b_{ij} to color comparator 65 of Fig. 8.

Fig. 9 is a block diagram showing another example of the color evaluating value adjusting circuit 60 of Fig. 7. In the embodiment of Fig. 8, an approach was shown where a predetermined attenuating amount Z is subtracted from color evaluating values r_{ij} and b_{ij} as an example of adjusting operation of color evaluating values in color evaluating value adjusting circuit 60. In the embodiment of Fig. 9, an approach is employed where a variable weighting amount is used.

Regarding regions where comparison signal S4 is at the L level, a predetermined weighting amount $D1'$ is weighted on color evaluating values by weighting circuits 101 and 103, that is to say, the multiplication of $r_{ij} \times D1'$ and $b_{ij} \times D1'$ are carried out. Regarding regions having H level comparison signal S4, weighting amount $D2'$ smaller than weighting amount $D1'$ is weighted by weighting circuits 100 and 102, that is to say, the multiplication of $r_{ij} \times D2'$ and $b_{ij} \times D2'$ are carried out. By providing there multiplied values as the modified color evaluating values of each region, it is possible to reduce the contribution degree towards white balance adjustment of the entire picture regarding regions satisfying both the conditions of $y_{ij} > n_y$ and $b_{ij} > N_b$.

It is possible to adjust proper white balance under various imaged sensing situations by implementation of selection of the specified region and color by an operation button of the operator.

According to the third embodiment of the present invention, the luminance degree towards white balance adjustment is reduced in situations where an object of the specified color exists in the specified regions to suppress white balance from being intense in the complementary side of a particular color.

Fig. 10 is a block diagram showing a white balance adjusting apparatus of a fourth embodiment of the present invention. The fourth embodiment of Fig. 10 is identical to the first embodiment of Fig. 2 except for the following points. That is, luminance signal y provided from camera processing and matrix circuit 6 is provided to a high pass filter (HPF) 31, where only the high frequency component YH is extracted and provided to selecting circuit 21. High frequency component YH increases in proportion to the contrast of the picture, that is to say, is great at the boundaries of objects in the picture. High frequency component YH is reduced as the contrast of the picture is lowered, that is to say, is low in portions of single color in the image sensed picture.

Selecting signal 21 is responsive to selection signal S1 produced in timing circuit 25 according to the vertical synchronizing signal provided from synchronizing separating circuit 24 to sequentially select any of luminance high frequency component YH, color difference signal R-Y amd color difference signal B-Y for each 1 field. For example, in the embodiment of Fig. 10, the luminance high frequency component or the color difference signals is selected by 1 field in the order of (YH) → (R-Y) → (B-Y) → (YH) → (R-Y) → ... , where the output is provided to A/D converter 22 of the succeeding stage.

A/D converter 22 samples signal YH or R-Y or B-Y selected by selecting circuit 21 by a predetermined sampling period to convert the same into a digital value. This digital value is provided to integrator 23.

Integrator 23 receives switching signal S2 to add the A/D converted values provided from selecting circuit 21 over 1 field period for every region, that is to say, digital-integrate the output of selecting signal 21 for the 64 regions. The digital-integrated value corresponding to each region is held in memory 26 as the contrast evaluating value or color evaluating value, when the integration over 1 field period is completed. As a result, the digital-integrated values of luminance high frequency band component YH corresponding to respective ones of 64 regions of an arbitrary field are obtained as 64 contrast evaluating values y'_{ij} (i,j:1-8). In the next field, color difference signal R-Y selected by selecting circuit 21 is integrated by integrator 23 for respective regions, where the digital-integrated values of color difference signal R-Y of respective regions are obtained as 64 color evaluating values r_{ij}. In the next field, color difference signal B-Y selected by

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selecting circuit 21 is integrated by integrator 23 for respective regions, where the digital-integrated values of color difference signal B-Y for respective regions are obtained as 64 color evaluating values b_{ij}.

Thus, a total of 64 x 3 = 192 of the contrast evaluating values y'_{ij} and color evaluating values r_{ij} and b_{ij} are held in memory 26, when integration over 3 field periods regarding luminance high frequency component YH, color difference signal R-Y, and color difference signal B-Y is completed. Similar operation is repeated, where a new contrast evaluating value y'_{ij} is provided to memory 26 at the next field, and color evaluating value r_{ij} is provided to memory 26 are at a further next field. The contrast evaluating value and color evaluating values held in memory 26 are updated sequentially. The latest evaluating values y'_{ij}, r_{ij}, b_{ij} calculated in the above manner and held in memory 26 are provided to color evaluating value adjusting circuit 95 of the succeeding stage.

Color evaluating value adjusting circuit 95 functions to make determination whether an object of single color exists or not in each region according to the magnitude of the contrast evaluating value. That is to say, color evaluating value adjusting circuit 95 functions to attenuate color evaluating values r_{ij} and b_{ij} of the corresponding region for reducing the contribution degree of the corresponding region towards white balance adjustment regarding region where the contrast evaluating value is low.

Fig. 11 is a block diagram of color evaluating value adjusting circuit 95. Referring to Fig. 11, contrast evaluating value y'_{ij} of each region is applied to a contrast comparator 80 starting from the top row region in the order of $y'_{11} \rightarrow y'_{12} \rightarrow \ldots, y'_{18}, y'_{21} \rightarrow \ldots \rightarrow y'_{88}$, to be sequentially compared with contrast threshold value N stored in a threshold value memory 81 in advance. When contrast evaluating value y'_{ij} is smaller than contrast threshold value N, comparison signal S5 of a H level is generated and provided to switching circuit 82.

Switching circuit 82 is constituted by two switches 83 and 84. Switch 83 functions to selectively connect a fixed contact 83a to which color evaluating value r_{ij} is applied to a fixed contact 83b coupled to R attenuator 85 or a fixed contact 83c coupled to output terminal 87. Switch 84 functions to selectively connect a fixed contact 84a to which color evaluating value b_{ij} is applied to a fixed contact 84b coupled to B attenuator 86 or a fixed contact 84c coupled to output terminal 88. Switches 83 and 84 are switching controlled synchronously with switching signal S5 from contrast comparator 80. When switching signal S5 is at the L level, switches 83 and 84 are switched to the sides of fixed contacts 83c and 84c, respectively, where the color evaluating values r_{ij} and bij of the corresponding region are provided to output terminals 87 and 88 without being attenuated. When switching signal S5 is at the H level, switches 83 and 84 are switched to the sides of fixed contacts 83b and 84b, respectively, where color evaluating values r_{ij} and b_{ij} of the corresponding region are provided to R and B attenuators 85 and 86.

R and B attenuators 85 and 86 subtract a predetermined amount Z' from the applied color evaluating values r_{ij} and b_{ij} to calculate $r_{ij} - Z'$ and $b_{ij} - Z'$. The result is provided to output terminals 87 and 88.

Contrast threshold value N is a value set according to observation values for recognizing an object of single color. The attenuating amount Z' is a value set according to observation values when appropriate white balance is obtained where an object of single color occupies a large area in the picture.

The attenuated or not attenuated color evaluating values provided from output terminals 87 and 88 are provided to picture evaluating circuit 28 of Fig. 10, where color evaluating values V_b and V_r of the entire picture are calculated according to these color evaluating values. The remaining operation is identical to that of the first embodiment of the Fig. 2 and the third embodiment of Fig. 7, and the description thereof will be omitted.

According to the fourth embodiment of the present invention, white balance is adjusted by attenuating the color evaluating values of the regions of low contrast. For example, in the case of an image sensed picture of Fig. 12 where a tree having deep green leaves is taken, the color evaluating values r_{ij} and b_{ij} of the 11 regions indicated by the hatched area having only deep green leaves with low contrast, i.e., regions A_{23}, A_{32}-A_{34}, A_{42}-A_{44}, A_{52}-A_{54}, and A_{63} are attenuated. Even in the case where a tree occupies a large area on the image sensed picture with uneven color distribution in the entire picture, the effect of the 11 green regions towards white balance of the entire picture is reduced to carry out appropriate white balance adjustment, without white balance canceling green components of the green leaves, that is, not intense in the complementary color side of green.

Fig. 13 is a block diagram showing another example of color evaluating value adjusting circuit 95 of Fig. 10. The embodiment of Fig. 11 has taken the approach of reducing a predetermined attenuating amount Z' from color evaluating values r_{ij} and b_{ij} as an example of adjusting operation of color evaluating values in color evaluating value adjusting circuit 95. In the embodiment of Fig. 13, an approach using variable weighting amounts is employed.

Regarding high contrast regions, a predetermined weighting amount $D1''$ is weighted on color evaluating values by weighting circuits 91 and 93, that is, the multiplication of $r_{ij} \times D1''$ and $b_{ij} \times D1''$ are carried out.

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Regarding low contrast regions, weighting amount D2″ smaller than weighting amount D1″ is weighted by weighting circuits 90 and 92. That is to say, the multiplication of r_{ij} x D2″ and b_{ij} x D2″ are carried out. By providing these multiplied values as the adjusted color evaluating values of each region, it is possible to reduce the contribution degree of low contrast regions towards white balance adjustment.

According to the fourth embodiment of the present invention, it is possible to carry out appropriate white balance adjustment without white balance being intense in the direction to cancel a particular single color, even in the case where color area distribution of the image sensed picture is uneven due to an object of single color occupying a large area in the image sensed picture.

Fig. 14 is a block diagram showing a white balance adjusting apparatus of a fifth embodiment of the present invention. The fifth embodiment of Fig. 14 is the same as the conventional example of Fig. 1 except for the following points. That is, the luminance signal Y produced in camera processing and matrix circuit 6 is applied to integrating circuit 19, as well as to video circuit 7. The luminance signal Y corresponding to one picture are integrated.

An upper limit value setting circuit 20 sets the maximum value of the gain control amount by gain control circuits 51 and 52 according to the value resulting from the above mentioned integration.

Fig. 15 is a graph showing the relation between the integrated value of luminance and the upper limit value of the gain control amount in the upper limit setting operation of upper limit value setting circuit 20. Referring to Fig. 15, the upper limit of gain control amount is fixed to 0 level, when the integrated value is extremely low. The upper limit value HJ increases in proportion to the integrated value. Upper limit value setting circuit 20 obtains upper limit value HJ of the gain control amount with respect to the entered luminance integrated value according to the graph of Fig. 15. Upper limit value HJ is provided to gain control circuits 51 and 52.

Gain control circuits 51 and 52 of Fig. 14 always monitor the levels of gain control signals G_r and G_b corresponding to the gain control amount, respectively. Gain control signals G_r and G_b are directly provided when less than or equal to upper limit value HJ set by upper limit value setting circuit 20. When more than upper limit value HJ, each gain control signal is limited, where the set upper limit value itself is provided. This means that when the luminance level of the picture is low, the integrated value of luminance is also low to reduce upper limit value HJ of the gain control amount. Particularly, when the picture is extremely dark, the upper limit value of the gain control amount becomes 0 to result in gain control signals G_r and G_b of 0. Unnecessary white balance adjustment is not carried out in this case due to prohibition of gain control.

Fig. 16 is a block diagram showing a white balance adjusting apparatus of a sixth embodiment of the present invention. The sixth embodiment of Fig. 16 is the same as the second embodiment of Fig. 6 except for the following points.

That is, the latest luminance evaluating value y_{ij} held in memory 26 is provided to weighting amount determining circuit 96, whereas color evaluating values r_{ij} and b_{ij} are provided to picture evaluating circuit 97.

Weighting amount determining circuit 96 detects regions where the luminance evaluating value is less than a predetermined value T to determine weighting amount w_{ij} for each region regarding color evaluating value r_{ij} and b_{ij} according to the determination results. More specifically, weighting amount w_{ij} is set to 1 in regions where the luminance evaluating value is equal or greater than a predetermined amount T, and to 1/2 in regions where the luminance evaluating value is less than a predetermined value T.

The predetermined value T is a luminance evaluating value set according to observation values for recognizing the offset of white balance where an object is of low luminance in the case where the weighting amount of all regions are identical.

Picture evaluating circuit 97 calculates color evaluating values of the entire picture of color difference signals R-Y and B-Y as picture color evaluating values V_r and V_b using weighting amount w_{ij} set by weighting amount determining circuit 96 for each region, according to the following equations (7) and (8).

$$V_r = \sum_{i=1}^{8} \sum_{j=1}^{8} (r_{ij} \times w_{ij}) / \sum_{i=1}^{8} \sum_{j=1}^{8} w_{ij} \quad \cdots (7)$$

$$V_b = \sum_{i=1}^{8} \sum_{j=1}^{8} (b_{ij} \times w_{ij}) / \sum_{i=1}^{8} \sum_{j=1}^{8} w_{ij} \quad \cdots (8)$$

The above equations will be described briefly. In equation (7),

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$$\sum_{i=1}^{8} \sum_{j=1}^{8} (r_{ij} \times w_{ij})$$

is the total sum of the multiplication results of all 64 regions, upon multiplying and weighting color evaluating values r_{ij} of the 64 regions by the corresponding weighting amount w_{ij}. Normalization by the weighting amount is carried out by dividing the above total sum by

$$\sum_{i=1}^{8} \sum_{j=1}^{8} w_{ij}$$

which is the total sum of the weighting amount of all regions. By summation and multiplying color evaluating values r_{ij} of color difference signal R-Y over the entire picture using weighting amount w_{ij}, picture color evaluating value V_r having the area factor removed is calculated. The above description regarding equation (7) may similarly be applied to equation (8).

The remaining operation is identical to that of the aforementioned first embodiment, and the description thereof will be omitted.

Although the sixth embodiment is implemented to select either 1 or 1/2 as the weighting amount, it is possible to implement the apparatus to select an optimum value from sequential weighting amount varying according to the luminance evaluating value as shown in the graph of Fig. 17, set in advance according to an observation value.

Although the upper limit value of the gain control amount is set in the above mentioned fifth embodiment, an approach could be taken to lengthen the time constant of gain variation, or to cease the gain control itself.

According to the aforementioned fifth and sixth embodiments, it is possible to suppress the offset of white balance to a minimum with respect to objects having extremely low luminance, by limiting the contribution of the low luminance object towards white balance adjustment of the entire picture.

It is possible to use digital integrator 23 of Fig. 4 as integrator 19 of the fifth embodiment of Fig. 14. In this case, the output of digital integrator 23 is the average value of the luminance evaluating values of the 64 regions.

The above embodiments are implemented to select one color difference signal or a luminance signal for every 1 field using selecting circuit 21 due to the common use of A/D converter 22. Therefore the update period of the evaluating values of each signal components are 3 fields. However, it is possible to carry out white balance adjustment of higher accuracy by providing an A/D converter and an integrator for each of luminance signal and color difference signals to allow update of each evaluating value for every 1 field.

It is also possible to carry out the determination using fuzzy inference considering that various determinations of the aforementioned embodiments comprise vagueness.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

Claims

1. A white balance adjusting apparatus for automatically adjusting white balance in response to a luminance information signal and a plurality of color information signals obtained from image sensing means having a lens (1) and an image sensing device (2), comprising:
means (4, 5) for amplifying each of said color information signals with a corresponding variable gain,
means (24, 25) for dividing an image sensed picture so as to set a plurality of regions on said image sensed picture,
means (21, 22, 23, 26) for averaging said luminance information signal and respective ones of said plurality of color information signals to convert the same into a luminance evaluating value and color evaluating values, respectively, for each of said plurality of regions,

means (28, 29, 30) for controlling the variable gain of said amplifying means according to each of said color evaluating values of each of said plurality of regions, and
means (27) for reducing the contribution degree of each color evaluating value towards the control of said variable gain in regions where said luminance evaluating value is greater than a predetermined value.

2. The white balance adjusting apparatus according to claim 1, wherein said reducing means comprises means (27) for reducing each color evaluating value by a predetermined amount in regions where said luminance evaluating value is greater than said predetermined value

3. The white balance adjusting apparatus according to claim 1, wherein said reducing means further comprises
means for weighting each color evaluating value in each of said plurality of regions with a weighting amount of the corresponding region, and
means (95) for reducing the weighting amount in regions where said luminance evaluating value is greater than a predetermined value, in comparison with the weighting amounts of other regions.

4. A white balance adjusting apparatus for automatically adjusting white balance in response to a luminance information signal and a plurality of color information signals obtained from image sensing means having a lens (1) and an image sensing device (2) , comprising:
means (4, 5) for amplifying each of said color information signals with a corresponding variable gain,
means (24, 25) for dividing an image sensed picture so as to set a plurality of regions on said image sensed picture,
means (21, 22, 23, 26) for averaginge each of said plurality of color information signals to convert the same into a color evaluating value for each of said plurality of regions,
means (50, 97) for calculating a picture color evaluating value of the entire picture regarding each of said plurality of color information signals, by weighting each color evaluating value of each of said plurality of regions by a weighting amount for each region,
means (29, 30) for controlling the variable gain of said amplifying means according to said picture color evaluating value, and
means (50, 96) for determining the weighting amount of each region according to said luminance information signal for each of said plurality of regions.

5. The white balance adjusting apparatus according to claim 4, further comprising means (21, 22, 23, 26) for averaging said luminance information signal to convert the same into a luminance evaluating value for each of said plurality of regions,
wherein said luminance evaluating value of each of said plurality of regions is used as the weighting amount of the corresponding region.

6. A white balance adjusting apparatus for automatically adjusting white balance in response to a luminance information signal and a plurality of color information signals obtained from image sensing means having a lens (1) and an image sensing device (2), comprising
means (4, 5) for amplifying each of said color information signals with a corresponding variable gain,
means (24, 25) for dividing an image sensed picture so as to set a plurality of regions on said image sensed picture,
means (21, 22, 23, 26) for averaging said luminance information signal and respective ones of said plurality of color information signals to convert the same into a luminance evaluating value and color evaluating values, respectively, for each of said plurality of regions,
means (28, 29, 30) for controlling the variable gain of said amplifying means according to each color evaluating value of each of said plurality of regions, and
means (60) for reducing the contribution degree of each color evaluating value in specified regions towards control of said variable gain, when the luminance evaluating value and a specified color evaluating value in said specified regions on an image sensed picture are greater than respective predetermined values.

7. The white balance adjusting apparatus according to claim 6, wherein said reducing means comprises means (60) for reducing each color evaluating value by a predetermined amount in specified regions where said luminance evaluating value and said specified color evaluating value are respectively greater than predetermined values.

8. A white balance adjusting apparatus for automatically adjusting white balance in response to a luminance information signal and a plurality of color information signals obtained from image sensing means having a lens (1) and an image sensing device (2), comprising:
means (4, 5) for amplifying each of said color information signal by a corresponding variable gain,
means (24, 25) for dividing an image sensed picture so as to set a plurality of regions on said image sensed picture,
means (21, 22, 23, 26) for averaging each of said plurality of color information signals to convert the same

into a color evaluating value for each of said plurality of regions,
means (31, 21, 22, 23) for calculating a contrast evaluating value indicating the contrast of an object for each of said plurality of regions according to said luminance information signal,
means (28, 29, 30) for controlling the variable gain of said amplifying means according to each color evaluating value of each of said plurality of regions, and
means (95) for reducing the contribution degree of each color evaluating value towards the control of said variable gain in regions where said contrast evaluating value is smaller than a predetermined value.

9 . The white balance adjusting apparatus according to claim 8, wherein said reducing means comprises means (95) for reducing each color evaluating value by a predetermined amount in regions where said contrast evaluating value is smaller than a predetermined value.

10. A white balance adjusting apparatus for automatically adjusting white balance in response to a luminance information signal and a plurality of color information signals obtained from image sensing means having a lens (1) and an image sensing device (2), comprising:
means (4, 5) for amplifying each of said color information signals with a corresponding variable gain,
means (17, 18) for averaging each of said plurality of color information signals,
means (13, 14) for controlling the variable gain of said amplifying means according to said averaged color information signal, and
means (19, 20, 51, 52) for limiting the control of said variable gain according to said luminance information signal.

11. The white balance adjusting apparatus according to claim 10, further comprising
means (19) for averaging said luminance information signal, and
means (20) for setting the upper limit of the control amount of said variable gain according to said averaged luminance information signal.

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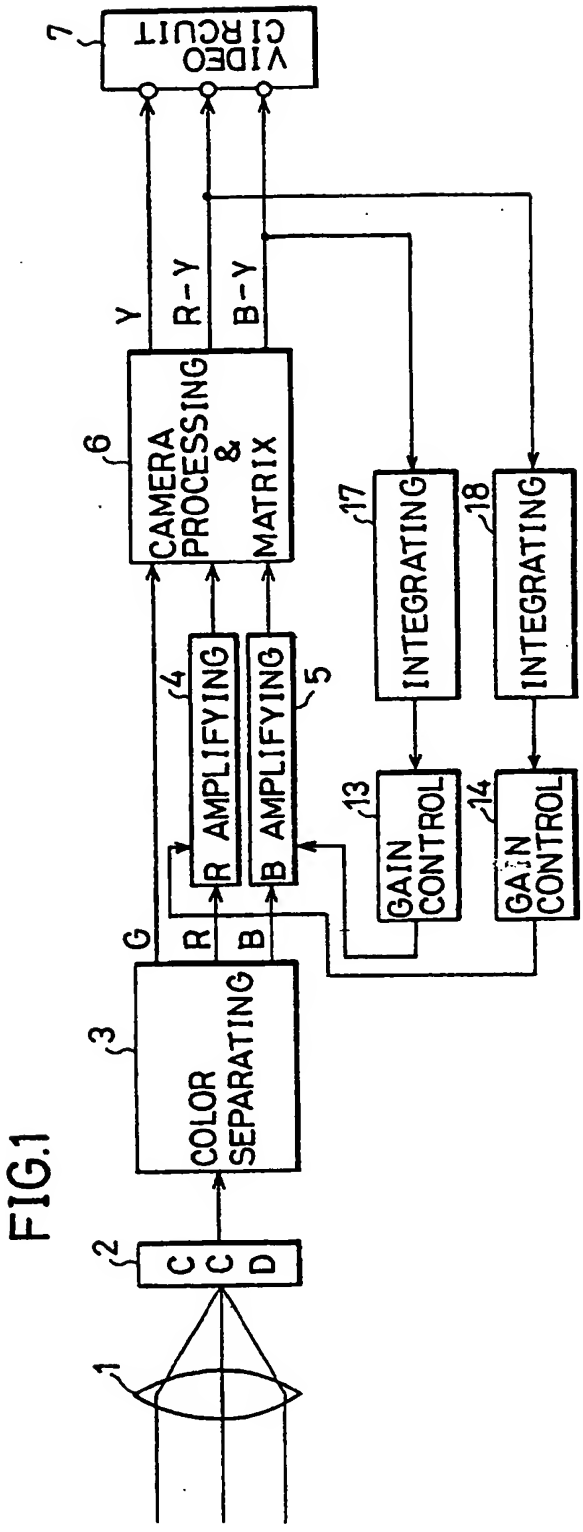

FIG.1

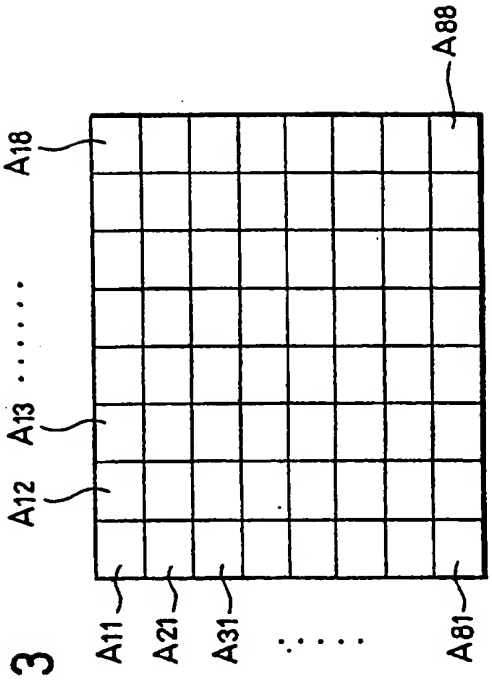

FIG.3

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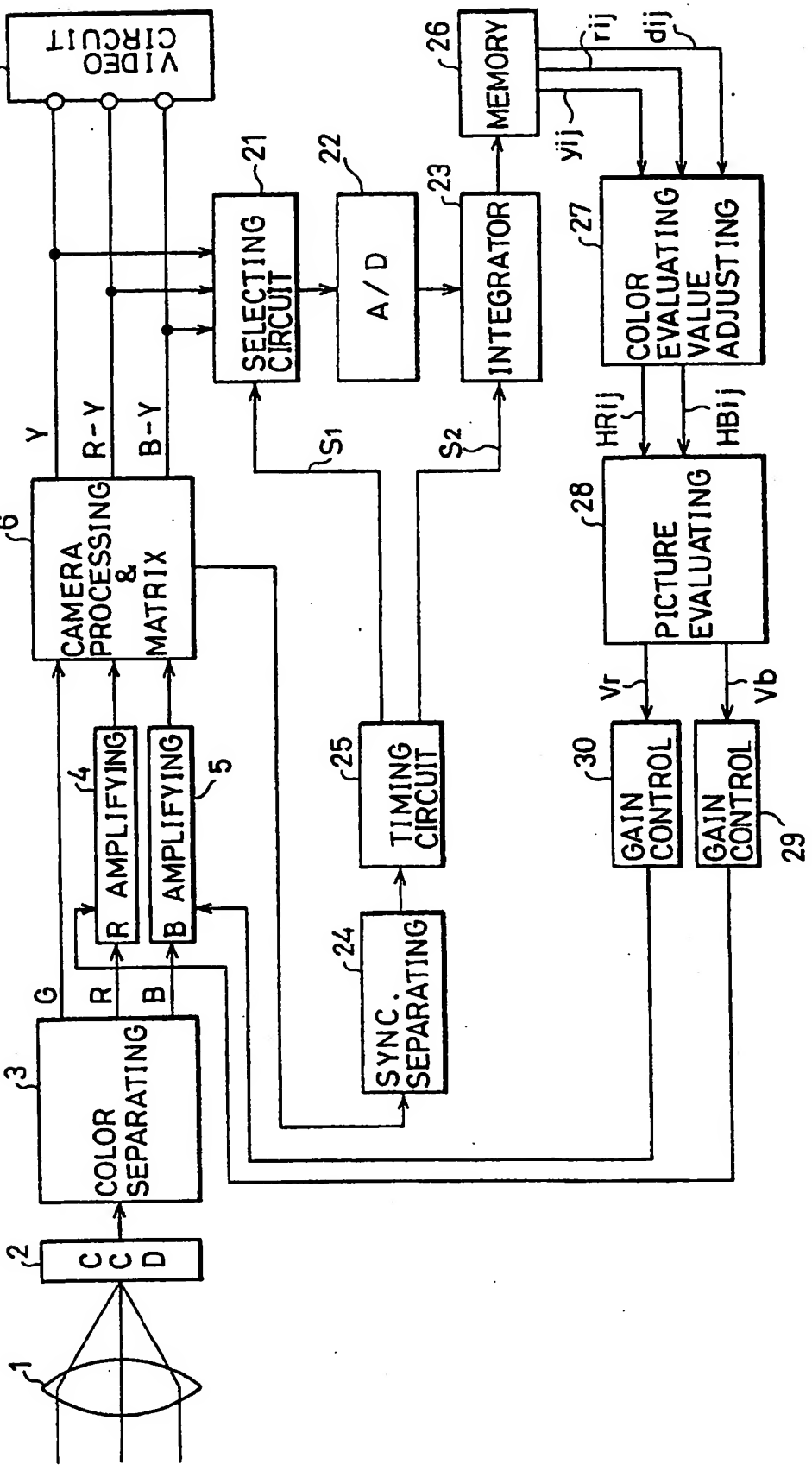
FIG.2



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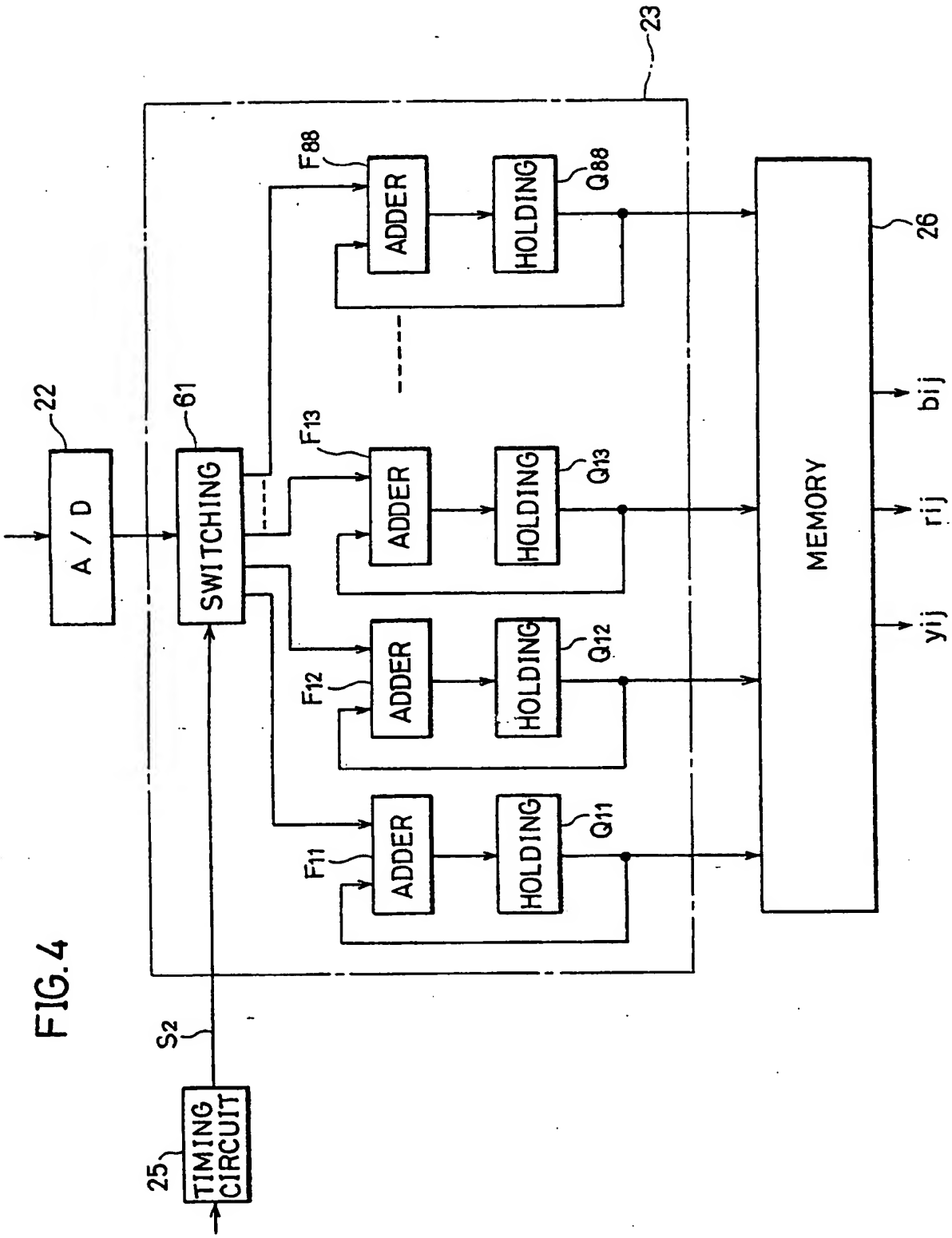

FIG.4

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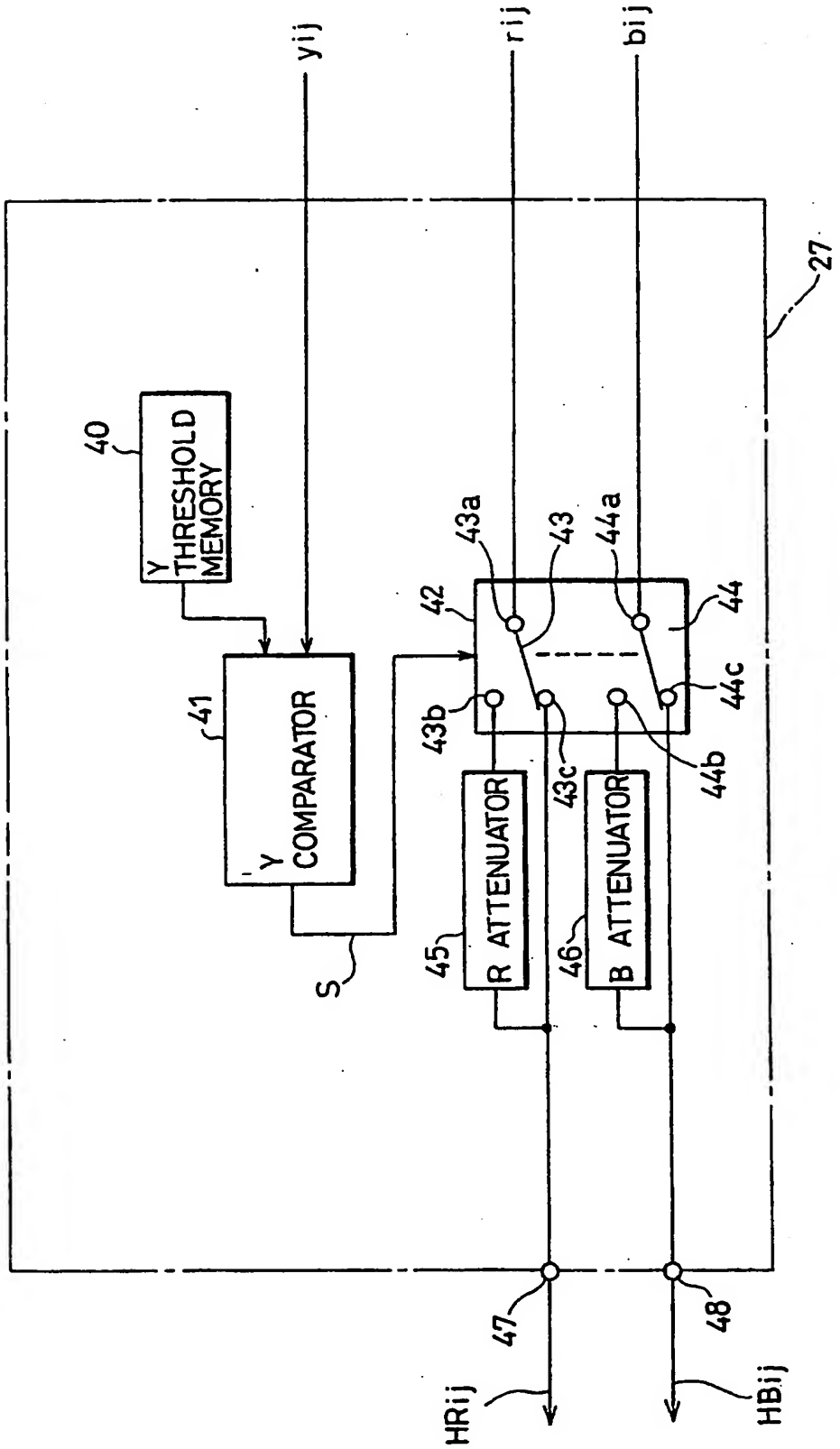

yij
rij
bij
27
40
Y THRESHOLD MEMORY
41
Y COMPARATOR
S
42
43a
43
44a
44
43b
43c
44b
44c
45
R ATTENUATOR
46
B ATTENUATOR
47
48
HRij
HBij

FIG.5A

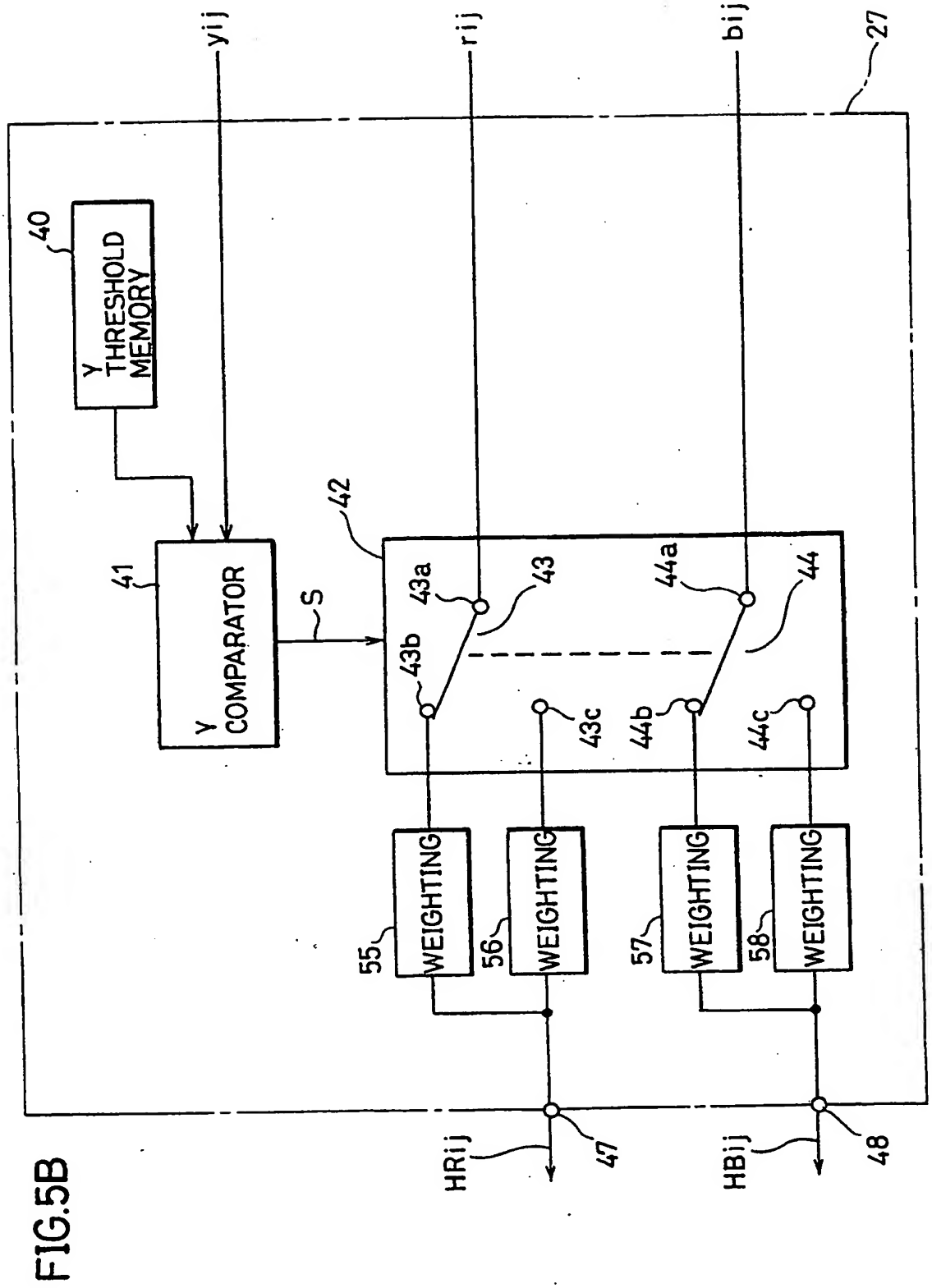

yij
rij
bij
27
40
Y THRESHOLD MEMORY
41
Y COMPARATOR
S
42
43a
43
43b
43c
44a
44
44b
44c
55
WEIGHTING
56
WEIGHTING
57
WEIGHTING
58
WEIGHTING
HRij
47
HBij
48

FIG.5B

FIG.6

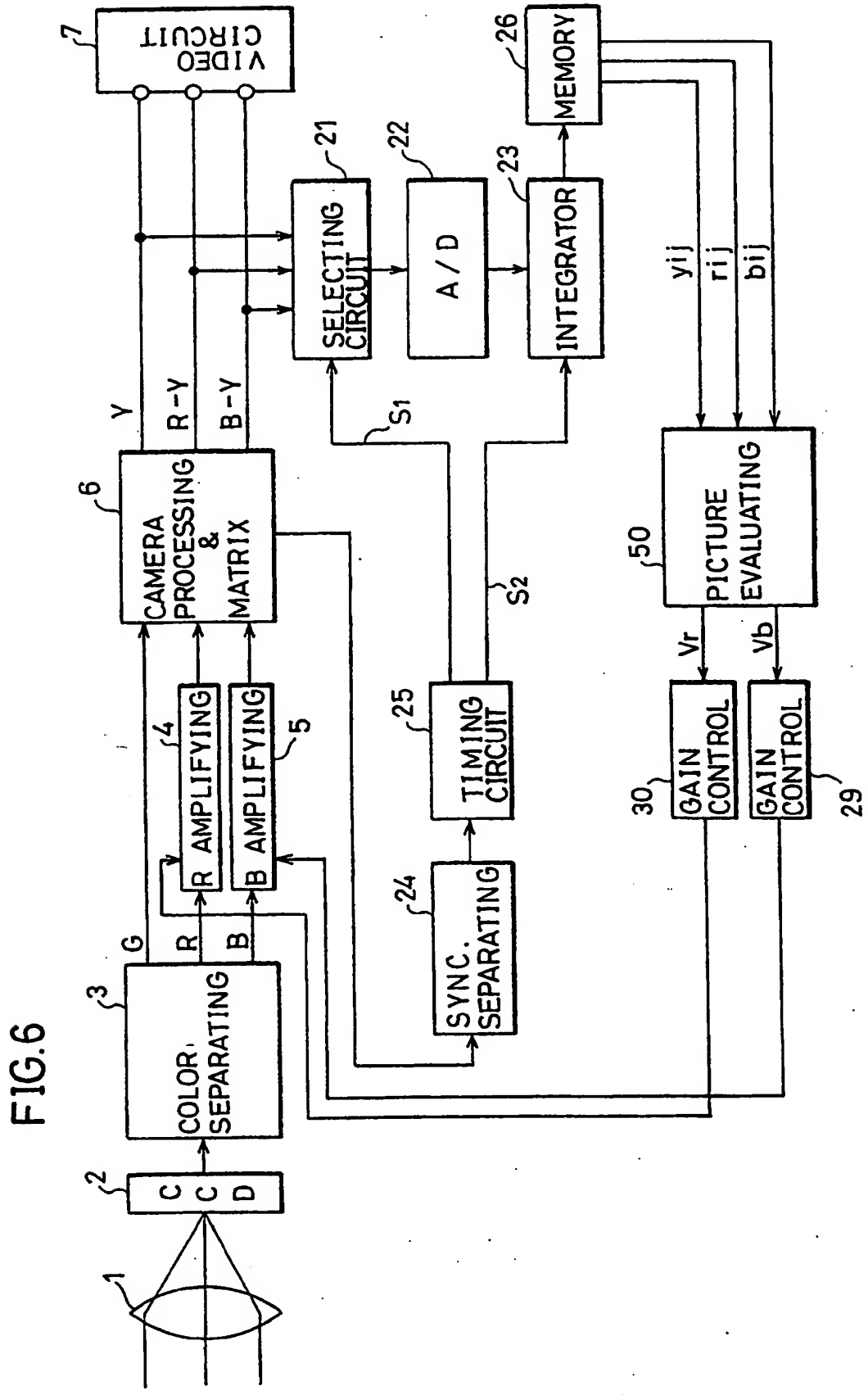
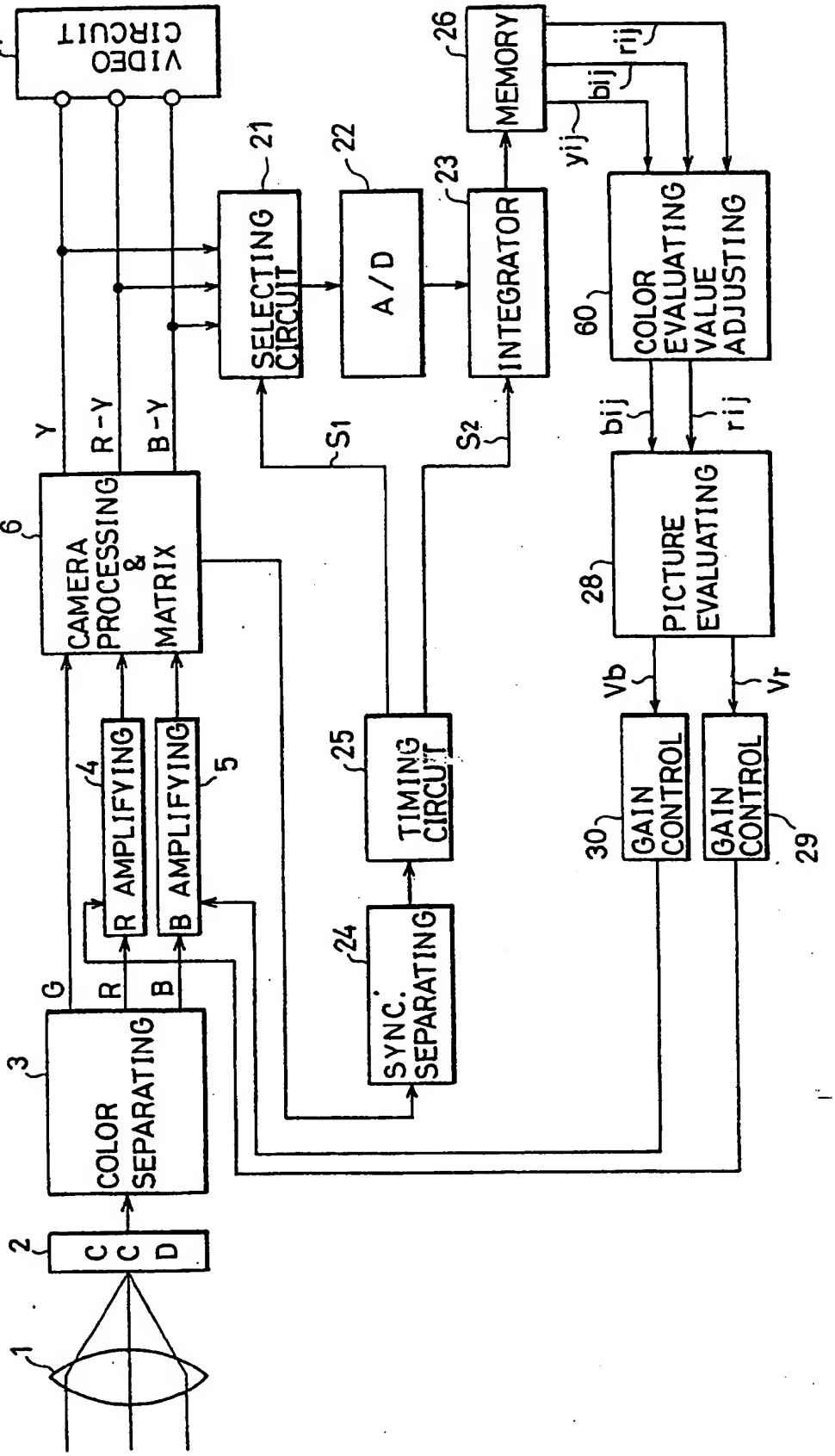
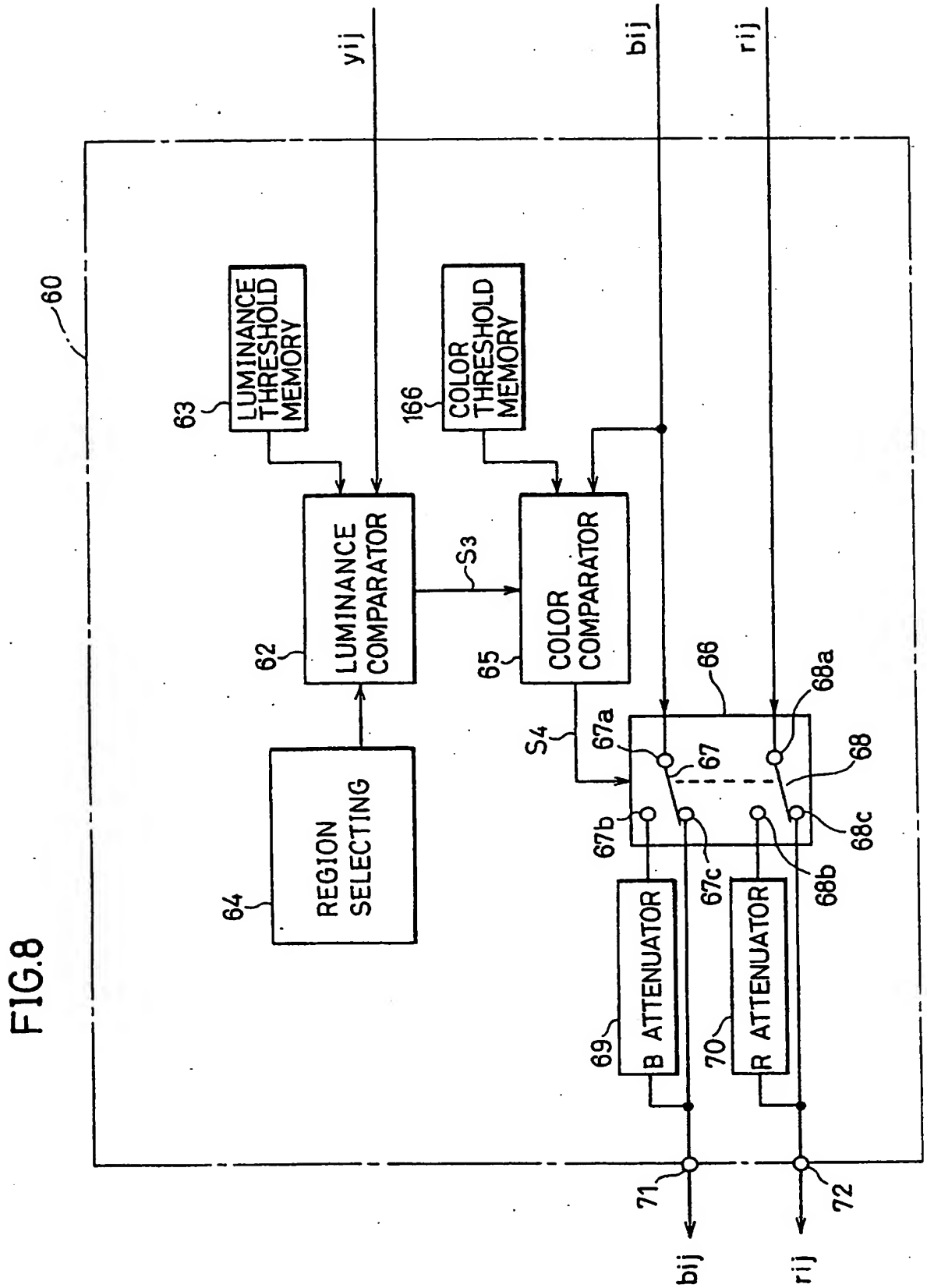

1
2
C
C
D
3
COLOR SEPARATING
G
R
B
4
R AMPLIFYING
5
B AMPLIFYING
6
CAMERA PROCESSING & MATRIX
Y
R-Y
B-Y
7
VIDEO CIRCUIT
21
SELECTING CIRCUIT
22
A/D
23
INTEGRATOR
26
MEMORY
S1
S2
24
SYNC. SEPARATING
25
TIMING CIRCUIT
50
PICTURE EVALUATING
yij
rij
bij
Vr
Vb
30
GAIN CONTROL
29
GAIN CONTROL

FIG.7



BNSDOCID: <EP 0429992A2 1 >

FIG.8


60
yij
bij
rij
63
LUMINANCE THRESHOLD MEMORY
166
COLOR THRESHOLD MEMORY
62
LUMINANCE COMPARATOR
S3
65
COLOR COMPARATOR
64
REGION SELECTING
S4
66
67a
67
68a
68
67b
67c
68b
68c
69
B ATTENUATOR
70
R ATTENUATOR
71
72
bij
rij

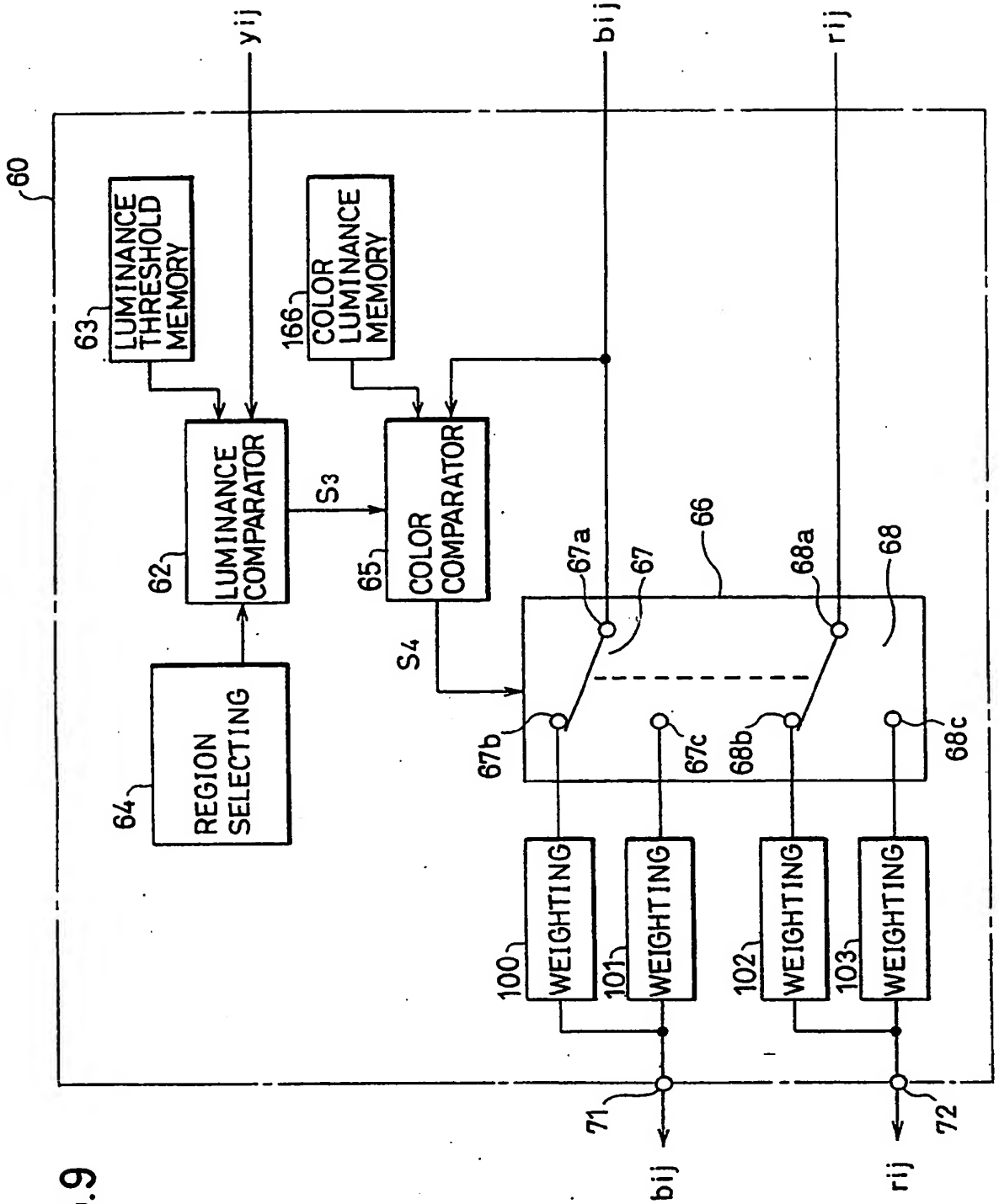


FIG.9

BNSDOCID: <EP 0429992A2 I >

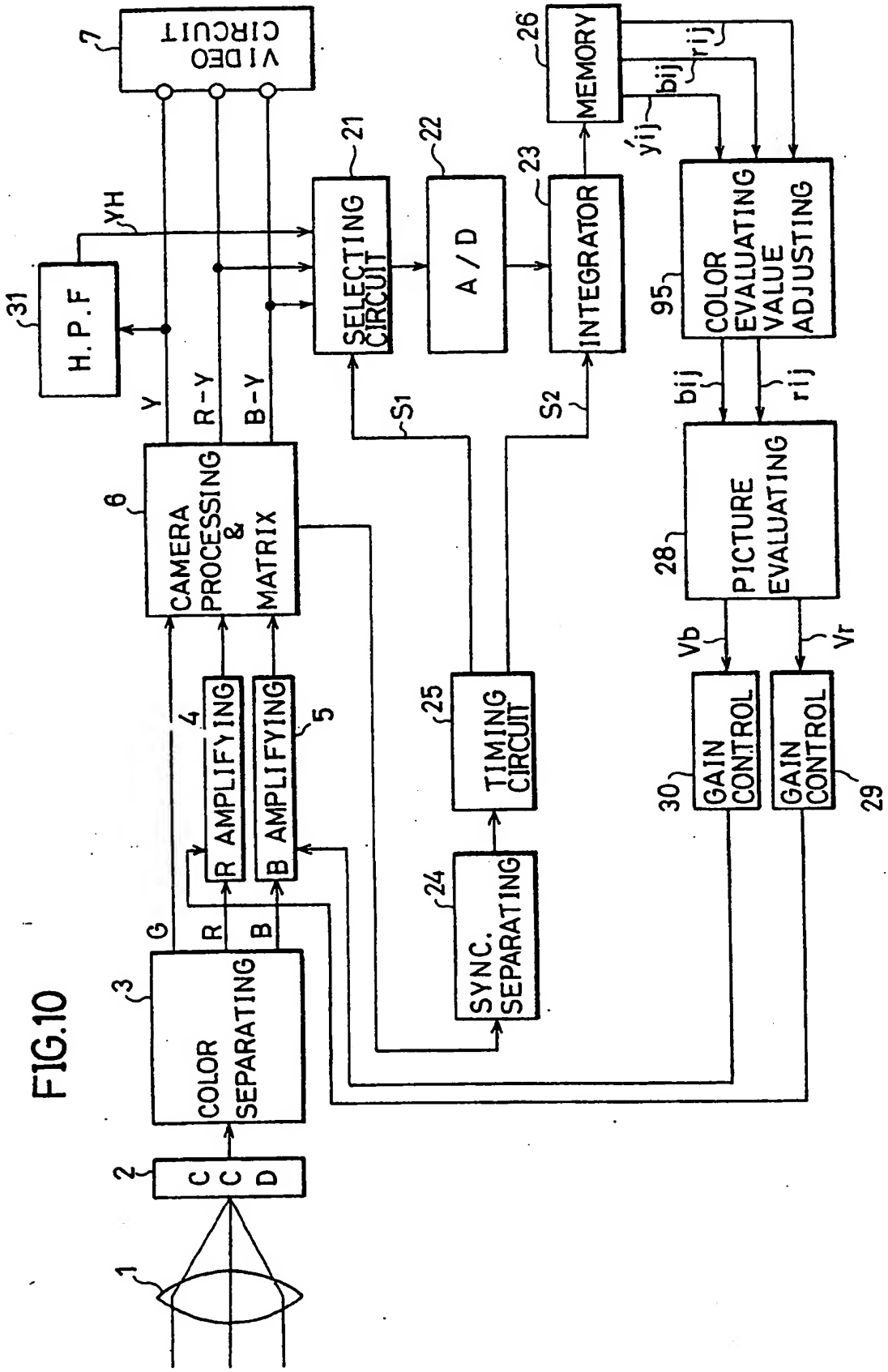

VIDEO CIRCUIT
7
MEMORY
26
rij
bij
yij
SELECTING CIRCUIT
21
A / D
22
INTEGRATOR
23
COLOR EVALUATING VALUE ADJUSTING
95
YH
H.P.F
31
Y
R-Y
B-Y
S1
S2
CAMERA PROCESSING & MATRIX
6
PICTURE EVALUATING
28
R AMPLIFYING
4
B AMPLIFYING
5
TIMING CIRCUIT
25
Vb
Vr
GAIN CONTROL
30
GAIN CONTROL
29
SYNC. SEPARATING
24
G
R
B
COLOR SEPARATING
3
CCD
2
1

FIG.10

FIG.11

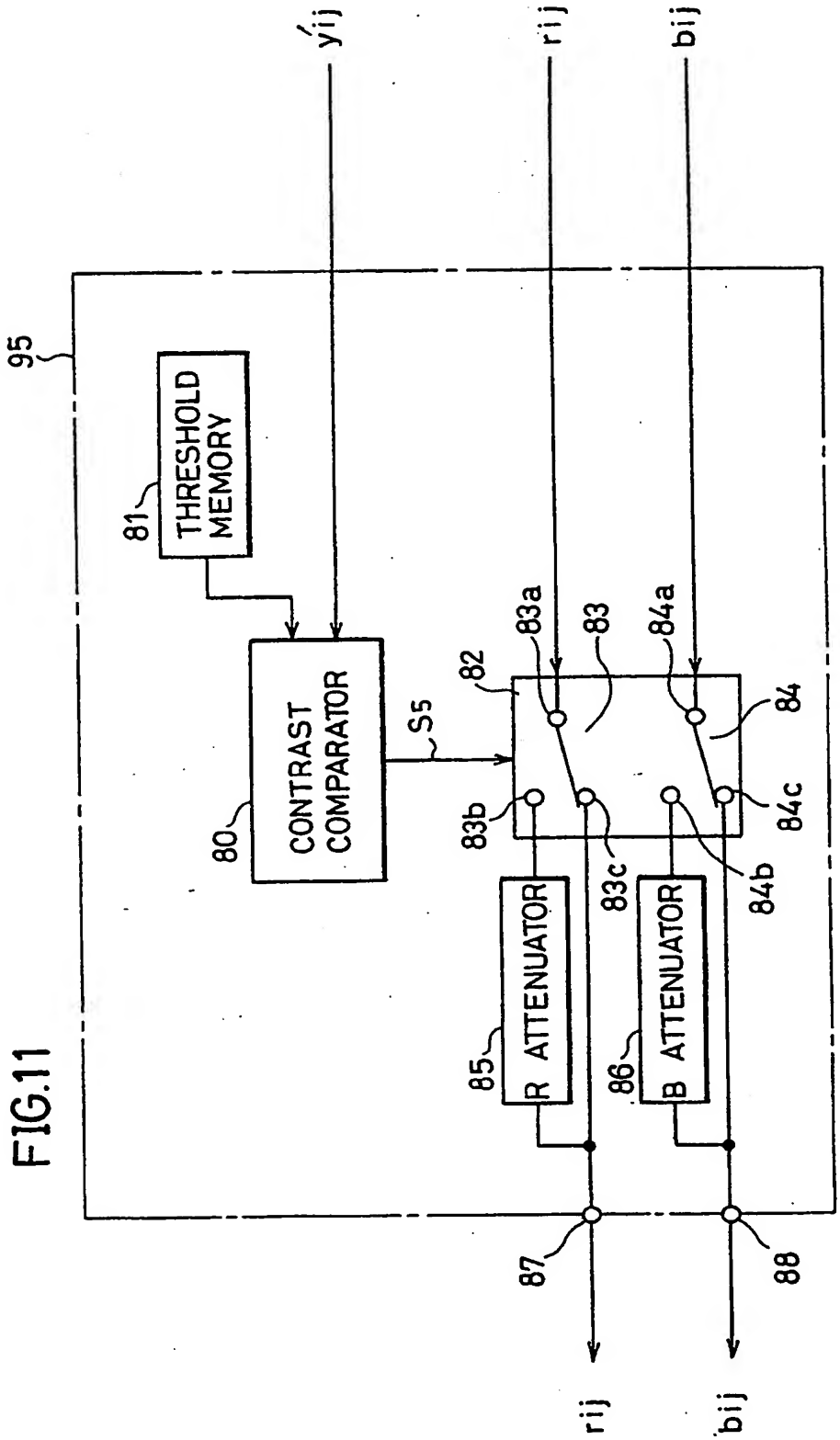

yij
rij
bij
95
THRESHOLD MEMORY
81
CONTRAST COMPARATOR
80
S5
82
83a
83
84a
84
83b
83c
84b
84c
R ATTENUATOR
85
B ATTENUATOR
86
87
88
rij
bij

FIG.12

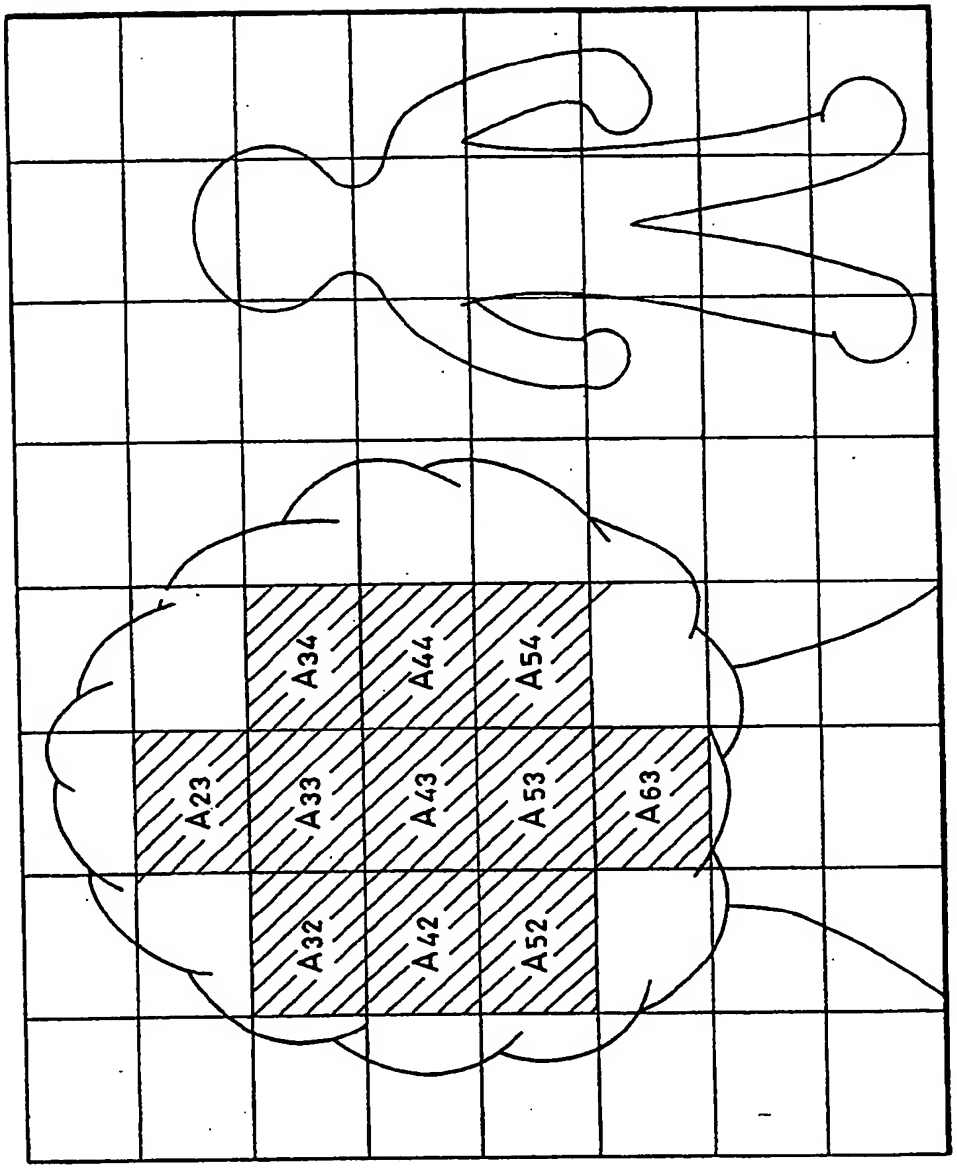


FIG.13

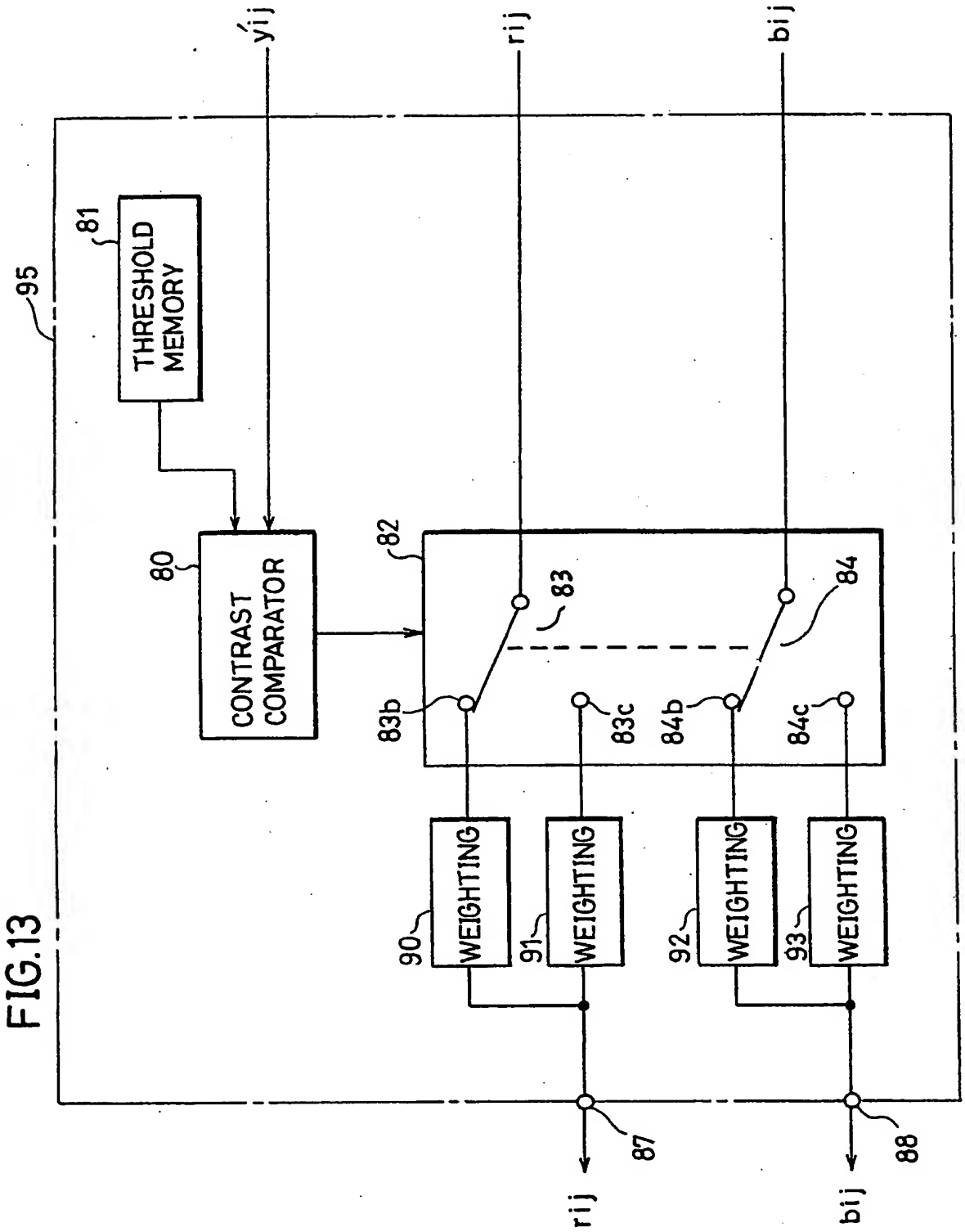


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FIG.14

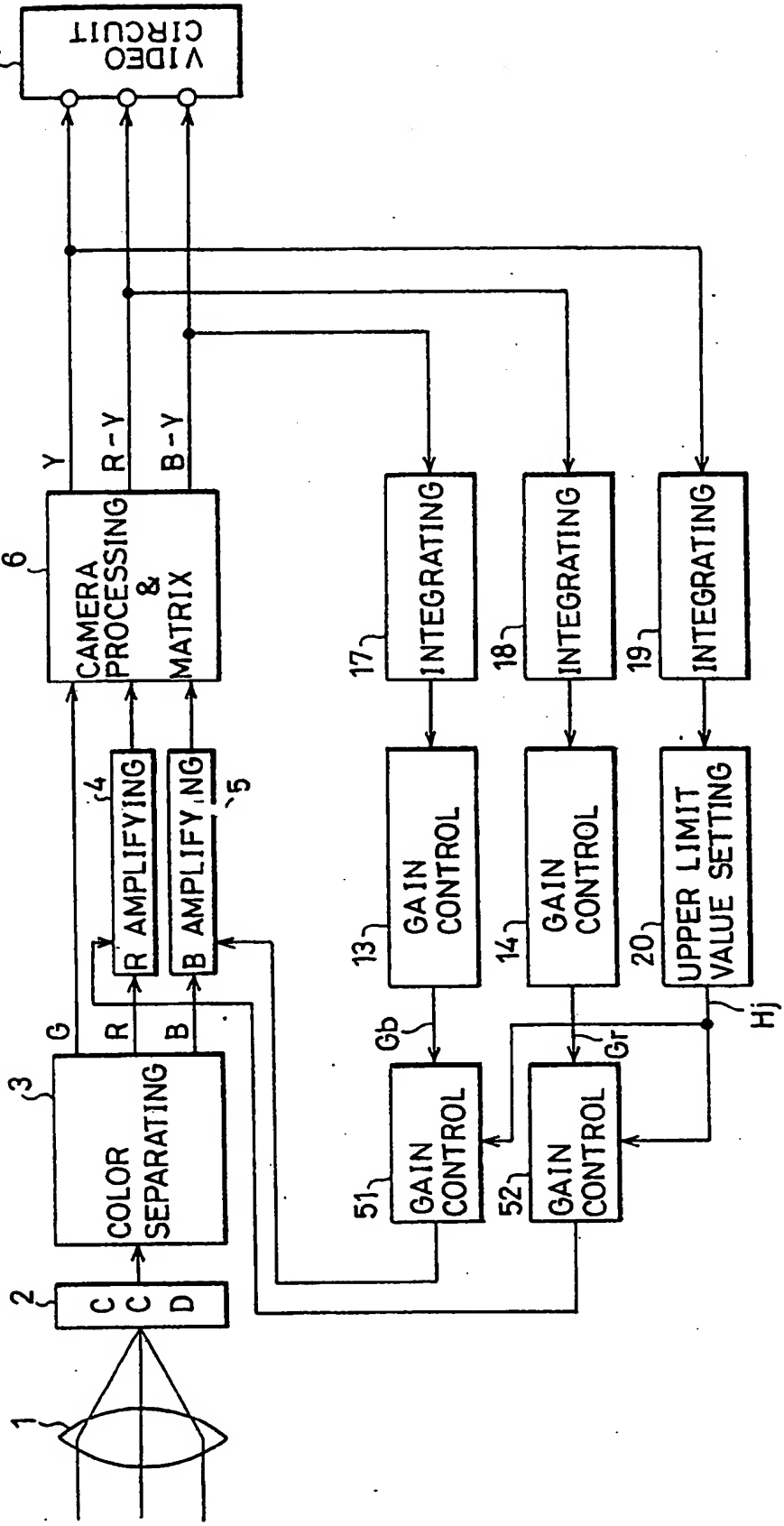
VIDEO CIRCUIT
7
Y
R-Y
B-Y
CAMERA PROCESSING & MATRIX
6
INTEGRATING
17
INTEGRATING
18
INTEGRATING
19
R AMPLIFYING
4
B AMPLIFYING
5
GAIN CONTROL
13
GAIN CONTROL
14
UPPER LIMIT VALUE SETTING
20
Hj
G
R
B
COLOR SEPARATING
3
Gb
Gr
GAIN CONTROL
51
GAIN CONTROL
52
C C D
2
1

FIG.15

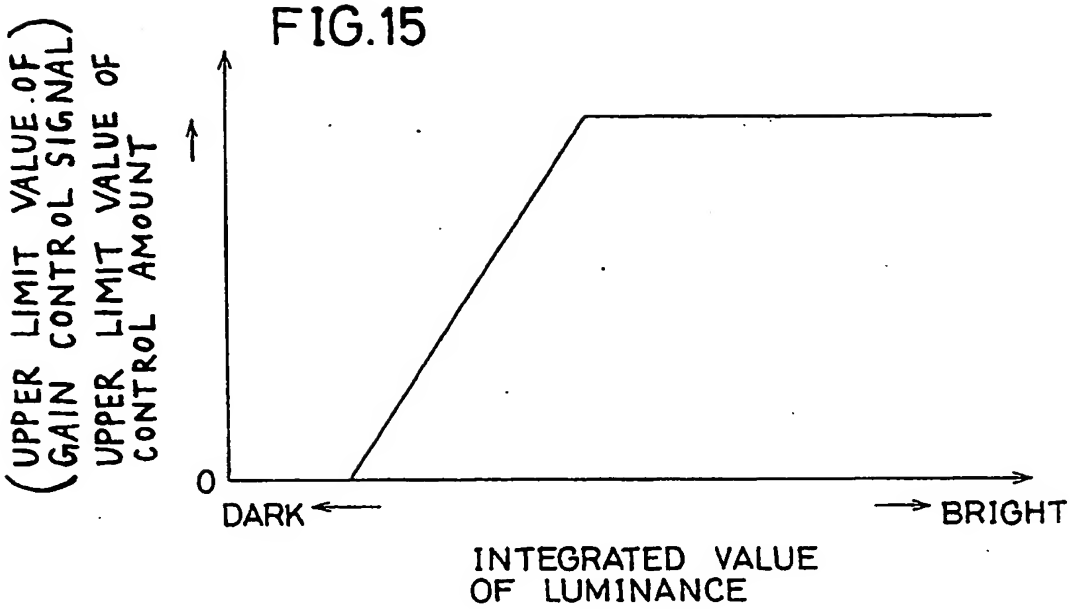

FIG.17

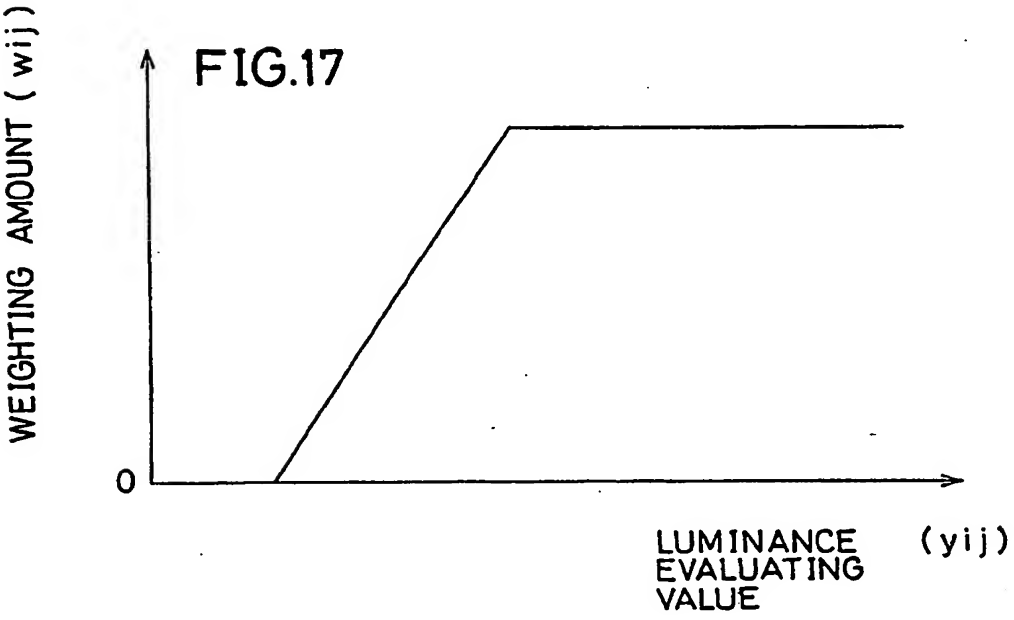

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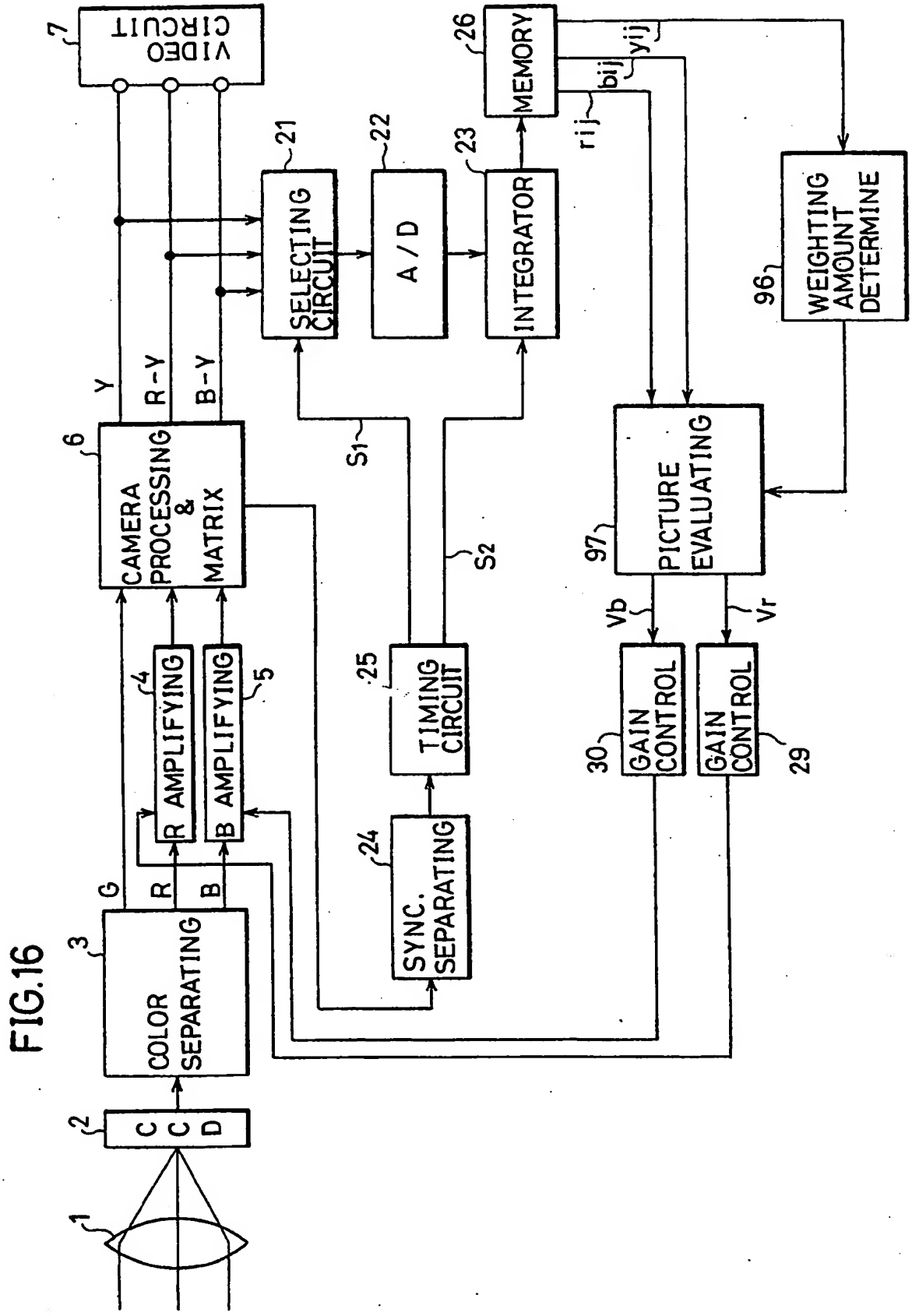
FIG.16


1
2
CCD
3
COLOR SEPARATING
G
R
B
4
R AMPLIFYING
5
B AMPLIFYING
6
CAMERA PROCESSING & MATRIX
Y
R-Y
B-Y
7
VIDEO CIRCUIT
21
SELECTING CIRCUIT
22
A/D
23
INTEGRATOR
26
MEMORY
rij
bij
yij
96
WEIGHTING AMOUNT DETERMINE
97
PICTURE EVALUATING
Vb
Vr
29
GAIN CONTROL
30
GAIN CONTROL
24
SYNC. SEPARATING
25
TIMING CIRCUIT
S1
S2